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ATOLL RESEARCH BULLETIN

18. Ichthyological Field Data of Raroia Atoll, Tuamotu Archipelago

by ROBERT R. HARRY

Issued by

THE PACIFIC SCIENCE BOARD

National Academy of Sciences—National Research Council

Washington, D. C., U.S.A.

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ACKNOWLEDGMENT

It is a pleasure to commend the far-sighted policy of the Office of Naval Research, with its emphasis on basic research, as a result of which a grant has made possible the continuation of the Coral Atoll Program of the Pacific Science Board.

It is of interest to note, historically, that much of the fundamental information on atolls of the Pacific was gathered by the U. S. Navy's South Pacific Exploring Expedition, over one hundred years ago, under the command of Captain Charles Wilkes. The continuing nature of such scientific interest by the Navy is shown by the support for the Pacific Science Board's research programs, CIMA, SIM, and ICCP, during the past six years. The Coral Atoll Program is a part of SIM.

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Ichthyological Field Data of Raroia Atoll, Tuamotu Archipelago

SCIENTIFIC INVESTIGATIONS IN MICRONESIA

Pacific Science Board

National Research Council

Robert R. Harry
Academy of Natural Sciences
Philadelphia, Pennsylvania
May, 1953.

PREFACE

In the last decade, almost all zoological (and particularly all ichthyological) investigations by the Office of Naval Research and Pacific Science Board in the Tropical Pacific have been in the Trust Territory and neighboring island groups, centering in the Gilbert, Marshall, Caroline and Mariana Islands.

The choice of Raroia Atoll in the heart of the Tuamotu Archipelago for the third low island in the Coral Atoll Program (1952 SIM Project of the Pacific Science Board of the National Research Council) provided the first time that ichthyological research had been sponsored in French Oceania by the U. S. Government since the Wilkes Expedition of 1838-1842, and the "Albatross" Expeditions of 1899-1900 and 1904-1905. The resumption of this interest in a little-known region of the tropical Pacific should prove very worthwhile, and the author, who participated in the Raroia program as ichthyologist, respectfully submits the following report of his field results.

Other reports that have a direct bearing on the fish study at Raroia are the general introduction and geological report by Dr. Norman D. Newell, the list of Raroian names for fishes by Bengt Danielsson and the author, the report by Bengt Danielsson on native fishing methods and his general report on the people of Raroia, and the general report on the ecology of Raroia by the entire field team under the editorship of Dr. Maxwell S. Doty.

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This section would be almost endless, if everybody were acknowledged that helped with the fish study at Raroia. The field work was made possible by the Coral Atoll Program of the Pacific Science Board of the National Research Council and was supported by funds granted to the National Academy of Sciences by Mr. George Vanderbilt and the Office of Naval Research. The fish program was also under the auspices of the Academy of Natural Sciences of Philadelphia and the California Academy of Sciences.

Generous cooperation was received from the enthusiastic team of scientists on the Raroia project, from the administrative officials of French Oceania, from Miss Ernestine Akers, Mrs. Lenore Smith, and Mr. Harold J. Coolidge of the Pacific Science Board, from Dr. Earl S. Herald of the California Academy of Sciences, from Miss Odette Vernaudon of Société Franco-Océanienne, Papeete, Tahiti, from Miss Aurore Natua of the Polynesian Museum in Papeete, from Mr. Edwin H. Bryan, Jr. of the Bernice P. Bishop Museum, from Dr. W. A. Gosline and his students at the University of Hawaii, and from the Office of Naval Research.

Words cannot express my gratitude to the people of Raroia. They were generous and cooperative beyond all expectations. And to Huri and Rago, who spent many days patiently teaching me what they know about their fishes, I am deeply thankful. All the publications on fishes together could not give the insight they imparted to me of the fish life on coral reefs.

Special credit should be given to Mr. George Vanderbilt, who generously made the fish study possible as a contribution to his over-all program of research on Pacific fishes. Mr. Vanderbilt provided almost all the fish equipment as well as additional funds necessary. And none the less important has been his sincere personal interest and inspiration to the author in his fish research.

Grateful thanks are also given to Miss Albertine Talis and Mrs. Aldona Mosinski for extensive aid in assembling this report, and to Miss Florence Sprague for preparing the illustrations. To all the remaining people who helped in the fish study I wish to express my gratitude and appreciation.

ILLUSTRATIONS

Figures

1. Field stations of the ichthyological survey.

2. Raroian names for the parts of a fish.

3. Ecological zonation of fishes on outside reefs.

4. Ecological zonation of fishes on shore reef face west side of Raroia Atoll.

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INTRODUCTION

Scope of Report

The purpose of this report is to present the ichthyological field data prepared at Raroia Atoll and subsequently assembled at the Academy of Natural Sciences of Philadelphia. It has been prepared to show the type and scope of information gathered, the general extent and size of the collections, and the field results obtained. It is hoped that this contribution will aid future Coral Atoll teams to correlate further the fish research program of the Pacific Science Board and to profit from the information gained on the Raroia study. While this paper should prove of some value to other ichthyologists, it is recommended that it not be cited until the final reports are published. The aim of this contribution is entirely for the benefit of the coral atoll studies of the Pacific Science Board, and definitely is not a formal systematic account, or a definitive study.

The studies of fishes have formed an important part of the Coral Atoll Projects of the Pacific Science Board. Large ichthyological collections and considerable data were obtained at Arno Atoll, Marshall Islands and Onotoa Atoll, Gilbert Islands in 1950 and 1951, respectively. As originally planned, the fish program was not to have received as much attention in the Raroia investigations. Dr. Morrison and Dr. Doty were to have given part of their time to prepare a fish collection, and to assemble data pertaining to the team study. It was also intended that the George Vanderbilt Pacific Equatorial Expedition, which was to have collected fishes in the Tuamotu Islands at the same time the Coral Atoll Project was being carried out at Raroia, would come to Raroia and aid the atoll team as much as possible. When it was learned that the Vanderbilt Expedition was postponed, it was suggested to Mr. Vanderbilt that one of the ichthyologists, who would have gone on his expedition, should be sent on the Coral Atoll Project. Mr. Vanderbilt wholeheartedly agreed and generously provided the funds for the author to carry out the ichthyological survey.

The aims of the ichthyological research at Raroia were dual: (1) to contribute to the Raroia team survey by studying the ecology and economic relationships of the fishes; and (2) to contribute to the Vanderbilt program in Polynesia by making as extensive observations and collections of the fishes as possible. Unfortunately neither program could be carried out as successfully as anticipated. Practically none of the ichthyological equipment was received because of the Pacific coast shipping strike. Some of the most important gear was repurchased in Honolulu, but it did not reach Raroia until the last two weeks available for collecting. As a result, the team was heavily dependent on the cooperation of the natives for transportation, assistance and fishing equipment.

At various times sailing canoes, outrigger canoes, outboard motor boats, an outboard motor, and a small cutter were made available by the natives for

transportation. Generally, three native assistants helped with the handling of the boats and the collecting. Dr. Newell made available his shallow water diving equipment for four stations in 20 to 40 feet of water. Many types of hooks and lines were tried and the natives were most helpful in providing this type of fishing gear. About three-fourths of the time at Raroia was spent in the field by the fish crew, and the remainder was used in preserving and packing the fishes and taking notes.

List of Basic Fish Equipment

The gear that was actually available for fish collecting is listed below. The items received during the last weeks of the survey are preceded by asterisks. The equipment that was strike-bound on the Matson ship "Sierra" is not listed.

Transportation: *5 horse outboard motor; anchors.

Spear fishing gear: *Champion rubber sling gun; *Hawaiian slings (2); *spear shafts with simple hinged barbs (6); simple spear loaned by native.

Swimming gear: Depth gauges (2); Swim fins (2 pr.); Snorkels (1); Tabe shoes (2 pr.); Squale face masks (2); *Diving underwear (1 pr.).

Ichthyocide gear: Rotenone-powdered (app. 385 lbs.); Cloth sacks (6); *Inner tube floats (2); Galvanized buckets (3); Dipnets--small (6); Dipnets--large (6); Shark repellent (20 pkgs.).

Fishing Tackle: Navy survival fishing kit; Assorted nylon lines; Assorted hooks loaned by natives.

Preservation: Formaldehyde (35 gals.); Washtubs (3); Porcelain and plastic trays (3); Museum jars 8 oz. (24); Screw top vials (50); Canning machine and 50 cans; cone soft string; Sodium borate (2 qts.); Cheese cloth 50 yard bolts (4); Burlap sacking 3 x 100'; Numbered tin tags.

Steel Drums: 54 gal. (5); *35 gal. (4).

Records: Collection resistall labels (400); Field data sheets (100); Record Books (3); Higgins Eternal ink and pens.

Fish Books: Tinker: Hawaiian fishes (1944); Schultz: Fishes of the Phoenix and Samoan Islands (1943); Fowler: Fishes of Oceania (1928).

Photographic Equipment: 35 mm. Kodak Signet, accessories, and film; 4 x 5 Speed Graphic, accessories, and film.

STATION RECORDS

During the two month survey at Raroia from June to August, approximately 60 different fish stations were studied. The most interesting collections and observations were made (1) in surge channels and on the outer reef flat on the leeward (west) side of the atoll; (2) on the windward lagoon shore reefs; (3) in inter-islet channels and the ship (Garue) Pass; and (4) on the southeastern and southwestern lagoon coral heads.

Approximately, 9,000 fishes of 400 species were collected at Raroia. All of them were preserved in 10% formalin and packed in five 54 gallon and four 35 gallon steel drums, and in 50 small tin cans and jars. At each station a United States National Museum Fish Division ecological data sheet was filled out and additional notes were taken when possible. A section of this data is presented below with each station outline. Notes on the fishes are not given, but can be traced back from stations listed for each species in the systematic account. Fig. 1 shows the location of each field station on a chart of Raroia kindly supplied by Dr. Norman D. Newell. The locality names are clarified in the report of Dr. Newell. At the suggestion of Bengt Danielsson all native "NG" sounds are spelled with only a "G" (e.g. the word pronounced "Nengo Nengo" is spelled "Nego nego").

During the return from Raroia to Tahiti, the natives at Takume presented me with a small local collection of reef fishes. This material was not examined in the field and is not incorporated in the present report. The same is true of several collections of market fishes obtained in the Papeete market, Tahiti, in early September.

Station 1.--Tahiti I., Society Islands; Shore reefs at Punaauia in Taapuna's pass area; 9½ kilometers west of Papeete, June 18. Vegetation: encrusting algae on live and dead coral. Time: 3-4:00 P.M. Bottom: sand and coral. Shore: coral sand. Current: app. 2 knots. Distance from shore: 10'. Tide: between high and low. Depth of capture: 8'. Depth of water: 8'. Method of capture: Tarzan spear gun. Collected by: John Vernaudon and R. Harry. One specimen of one species.

Station 2.--Tahiti; 6 kilometers west of Papeete; coral reefs bordering "Les Tropiques" Hotel, next to lagoon, June 20. Vegetation: encrusting algae. Time: 10-11 P.M. Bottom: coral and coral rubble. Shore: beachrock. Distance from shore: 0-100 yards. Tide: high. Depth of capture: 0-2'. Depth of water: 0-2'. Method of capture: dipnets. Collected by: John Byrne and R. Harry. 45 specimens of 10 species.

Station 3.--Tahiti; shore reefs at Punaaiua in Taapuna's pass area, 9½ kilometers west of Papeete, June 20. Vegetation: encrusting algae on live and dead coral. Time: 9-12 A.M. Bottom: coral sand, live and dead coral. Shore: coral sand. Current: app. 2 knots. Distance from shore: app. 300 yards. Tide: between low and high. Depth of capture: 0-6'. Depth of water: 0-6'. Method of capture: rotenone (app. 8 lbs.) and dipnets. Collected by: John Vernaudon and R. Harry. 250 specimens of 47 species.

Station 4.--Tahiti; encircling reefs of Motu Uta Islet in Papeete Harbor, June 21. Vegetation: encrusting algae on live and dead coral. Time: 8:30-11 A.M. Bottom: coral sand, live and dead coral. Shore: coral. Current: very slight. Distance from shore: app. 50 yards. Tide: between low and high. Depth of capture: 0-15'. Depth of water: 0-15'. Method of capture: rotenone (app. 8 lbs.) and dipnets. Collected by: J. Vernaudon and R. Harry. App. 125 specimens of 25 species.

Station 5.--Tahiti; shore reefs at Punaauia in Taapuna's Pass area. $9\frac{1}{2}$ kilometers west of Papeete, June 22. Vegetation: encrusting algae on live and dead coral. Time: 7:30-11 A.M. Bottom: coral sand and coral. Shore: coral sand. Current: app. 1 knot. Distance from shore: app. 100 yards. Tide: low. Depth of capture: 0-12'. Depth of water: 0-12'. Method of capture: rotenone (app. 8 lbs.) and dipnets. Collected by: J. and O. Vernaudon, R. Harry. App. 150 specimens of 30 species.

Station 6.--Tahiti; purchased in Papeete Central Market, June 22. Time: 6 A.M. Obtained by R. Harry. 50 specimens of 15 species.

Station 7.--Raroia Island, Tuamotu Archipelago (app. 16° 1' S. 142° 26' W., H. O. Chart 2004); coral head off Garumaoa Village jetty, west side of lagoon, June 30. Vegetation: encrusting algae. Time: 2-5 P.M. Bottom: coral sand and 100' wide flat-topped coral head rising straight from flat sand bottom 20-25'. Shore: coral sand. Current: practically none. Distance from shore: app. 250 yards. Tide: high. Depth of capture: 0-20'. Depth of water: 0-20'. Method of capture: rotenone (app. 15 lbs.) and dipnets. Collected by M. Doty, B. Danielsson, Tetohu, R. Harry. App. 300 specimens of 60 species.

Station 8.--Raroia; Channel between Kumekume and Garumaoa (Korere) Islets, near Garumaoa Village, July 1. Vegetation: encrusting algae on dead coral and beach rock. Time: 9-11:40 A.M. Bottom: Coral sand, gravel, beach rock, dead coral. Shore: beach rock, dead coral. Current: 0-$\frac{1}{4}$ knot. Distance from shore: 0-25'. Tide: between low and high. Depth of capture: 0-$2\frac{1}{2}$'. Depth of water: 0-$2\frac{1}{2}$'. Method of capture: rotenone (app. 8 lbs.) and dipnets. Collected by: M. Doty, W. Newhouse, R. Harry. App. 450 specimens of 35 species.

Station 9.--Raroia; coral shelf near jetty next to lagoon shore between Ohue coral head and Garumaoa Village, July 1. Vegetation: encrusting algae on live and dead coral. Time: 2:15-5:15 P.M. Bottom: coral sand and dead coral. Shore: coral sand. Current: slight toward shore. Distance from shore: app. 100 yards. Tide: between high and low. Depth of capture: 0-20'. Depth of water: 0-20'. Method of capture: rotenone (app. 12 lbs.) and dipnets. Collected by: M. Doty, W. Newhouse, R. Harry. App. 450 specimens of 60 species.

Station 10.--Raroia; outer reef near Garumaoa village on west side of atoll on shallow tidal flat next to shore, July 3. Vegetation: sparse coralline algae. Time: 3-5:40 P.M. Bottom: coral sand, live and dead

coral. Shore: beach rock. Current: app. $\frac{1}{4}$ knot along shore. Distance from shore: 0-100 yards. Tide: extreme low. Depth of capture: 0-6". Depth of water: 6". Method of capture: rotenone (4 lbs.) and dipnets. Collected by: M. Doty, W. Newhouse, R. Harry. App. 325 specimens of 35 species. Aug. 25. Collected by: J. Morrison. 2 specimens of 2 species.

Station 11.--Raroia; channel between Takeke and Temari Islets, near Garue North Passage, west side of atoll, July 4. Vegetation: encrusting algae. Time: 8-11:15 A.M. Bottom: coral sand, dead coral, some live coral. Shore: dead coral and beach rock. Current: app. 1 knot. Distance from shore: 0-100'. Tide: just after low tide. Method of capture: rotenone (6 lbs.) and dipnets. Collected by: R. Harry. App. 220 specimens of 35 species.

Station 12.--Raroia; in lagoon off pier at Garumaoa Village on top of reefs, west side of atoll, July 5. Vegetation: encrusting algae. Time: 8:30-9:30 A.M. Bottom: coral sand, dead and live coral. Shore: coral sand. Current: none. Distance from shore: 0-100 yards. Depth of capture: 0-3'. Depth of water: 3'. Method of capture: rotenone (app. 10 lbs.) and dipnets. Collected by: J. Morrison, Raroian natives, R. Harry. 40 specimens of 18 species.

Station 13.--Raroia; "Ohava" coral head in lagoon off Garumaoa Village, west side of atoll, July 5. Vegetation: encrusting algae. Time: 2:30-4:15 P.M. Bottom: coral sand, live and dead coral. Shore: coral sand. Current: very slight. Distance from shore: about 3/4 mile. Tide: between low and high. Depth of capture: 0-20'. Depth of water: 1-20'. Method of capture: rotenone (7 lbs.) and dipnets. Collected by: M. Doty, N. Newell, natives, R. Harry. 100 specimens of 35 species.

Station 14.--Raroia; channel between Geogeo and Kukina Islets, near Garumaoa Village, west side of atoll, July 6. Vegetation: encrusting algae. Time: 7:30-11:30 A.M. Bottom: coral sand, live and dead coral. Shore: gravel, beach rock. Current: none to 1 knot. Distance from shore: 0-100'. Tide: extreme low. Depth of capture: 0-1$\frac{1}{2}$'. Depth of water: 6"-1$\frac{1}{2}$'. Method of capture: rotenone (app. 6 lbs.) and dipnets. Collected by: R. Harry. 200 specimens of 28 species.

Station 15.--Raroia; North Pass, near Garumaoa Village on west side of atoll, July 7. Vegetation: encrusting and low green algae. Time: afternoon. Bottom: sand, coral. Shore: beach rock. Current: various, usually up to 5 knots. Distance from shore: 100-400'. Tide: various. Depth of capture: 10-35'. Depth of water: 25-40'. Method of capture: hook and line. Collected by: native for R. Harry. 2 specimens of 2 species.

Station 16.--Raroia; near Garumaoa Village on outer reef flat, July 8, Aug. 20, Sept. 2. Vegetation: encrusting algae, lithothamnion ridge. Bottom: coral, beach rock, sand. Shore: beach rock. Current: 0-3 knots. Distance from shore: 0-150 yards. Depth of capture: 0-1'. Depth of water: 6"-1'. Method of capture: dipnets, spears. Collected by: J. Morrison, R. Harry. 13 specimens of 10 species.

Station 17.--Raroia; first transect in open channels on edge of outer reef, near Garumaoa Village, west side of atoll, July 9. Vegetation: encrusting algae, lithothamnion ridge. Time: 9-12 A.M. Bottom: coral, beachrock, algae. Shore: beachrock. Current: strong surge. Distance from shore: App. 200 yards. Tide: extreme low. Depth of capture: 0-15'. Depth of water: 1-15'. Method of capture: rotenone (8 lbs.) and dipnets. Collected by: Tetohu, R. Harry. 500 specimens of 55 species.

Station 18.--Raroia; first transect on outer open reef flat near Garumaoa Village, west side of atoll, July 10. Vegetation: encrusting algae. Time: 2-3 P.M. Bottom: beachrock, coral, algae. Shore: beachrock. Current: surging. Distance from shore: app. 50-100 yards. Tide: between low and high. Depth of capture: 6". Depth of water: 6". Method of capture: dipnet. Collected by: R. Harry. One specimen, one species.

Station 19.--Raroia; channel and leeward outer reef north of Garue Pass between Kahogi and Fakatomo Islets, July 11. Vegetation: encrusting algae. Time: 8:30-11:30 A.M. Bottom: algae, coral, beachrock. Shore: beachrock. Current: strong with surge. Distance from shore: 100-200 yards. Tide: between high and low. Depth of capture: 0-5'. Depth of water: 1-5'. Method of capture: single and three pronged spears. Collected by: natives and R. Harry. 5 specimens of 5 species.

Station 20.--Raroia; first transect on outer open reef flat near Garumaoa Village, west side of atoll, July 11. Vegetation: encrusting algae. Time: 1-3 P.M. Bottom: sand, coral, algae. Shore: beachrock. Current: 0-4 knots. Distance from shore: 0-100 yards. Tide: just after low. Depth of capture: 0-1'. Depth of water: 1'. Method of capture: rotenone (app. 6 lbs.) and dipnets. Collected by: R. Harry. 50 specimens of 23 species.

Station 21.--Raroia; Tahiti islet app. 2 miles south of Garumaoa Village, west side of atoll, July 12. Vegetation: encrusting algae. Time: 8:30-11 A.M. Bottom: sand, gravel, beachrock. Shore: beachrock. Current: 1-5 knots and surge. Distance from shore: 50-100 yards. Tide: between high and low. Depth of capture: 0-4'. Depth of water: 4'. Method of capture: 1 and 3 pronged spears. Collected by: B. Danielsson, natives, R. Harry. 3 specimens of 3 species.

Station 22.--Raroia; Mataira Islet, north of Garue Pass, west side of atoll, July 17. Vegetation: encrusting algae. Time: 6:30 A.M.-11 P.M. Bottom: beachrock, coral sand, coral. Shore: beachrock. Current: 0-4 knots. Distance from shore: 0-200 yards. Depth of capture: 0-3'. Depth of water: 3-6'. Method of capture: rotenone (8 lbs.) spears, dipnets. Collected by: natives, R. Harry. 440 specimens of 65 species.

Station 23.--Raroia; first transect on outer open reef flat near Garumaoa Village, west side of atoll, July 18. Vegetation: encrusting algae. Time: 9:30-12:30 P.M., 1:30-4:00 P.M. Bottom: coral, coral sand. Shore: gravel, beachrock. Current: 0-1 knot. Distance from shore: 50-100

yards. Tide: mid-low to high to mid-low. Depth of capture: 0-25'. Depth of water: 2-25'. Method of capture: rotenone (app. 12 lbs.) and dipnets. Collected by: Tetohu, Peni, R. Harry. 410 specimens of 63 species.

Station 24.--Raroia; Tetou Islet, largest islet on east side of atoll, channel on lagoon side, July 19. Vegetation: encrusting algae. Time: 9:30 A.M.-1 P.M. Bottom: sand, coral. Shore: sand, gravel, beachrock. Current: 5-8 knots. Distance from shore: 50-100 yards. Tide: low to high. Depth of capture: 0-10'. Depth of water: 8-10'. Method of capture: hook and line. Collected by: natives, R. Harry. 5 specimens of 4 species.

Station 25.--Raroia; channel between Temari and Kumekume Islets, immediately south of Garue Pass, July 20. Vegetation: encrusting algae. Time: 9-11:30 A.M. Bottom: beachrock, sand, coral. Shore: beachrock. Distance from shore: 0-20'. Current: none. Depth of capture: app. 6". Depth of water: app. 6". Method of capture: by hand. Collected by: J. Morrison for R. Harry. 12 specimens of 3 species.

Station 26.--Raroia; first transect at excurrent channel, and ridge channels of the lithothamnion ridge, July 21. Vegetation: encrusting algae, lithothamnion ridge. Time: 9:45 -12A.M. Bottom: beachrock, gravel. Shore: beachrock. Current: surf and turbulent surge. Distance from shore: app. 200 yards. Tide: extreme low. Depth of capture: 0-25'. Depth of water: 5-25'. Method of capture: rotenone (app. 15 lbs.) dipnets, spears. Collected by: Peni, Tetohu, R. Harry. 840 specimens of 56 species.

Station 27.--Raroia; outer reef surge channels at lithothamnion ridge at Garumaoa Village, west side of atoll, July 22. Vegetation: encrusting algae. Time: 11 A.M.-1:30 P.M., 8-11 P.M. Bottom: coral. Shore: Beachrock. Current: surf. Distance from shore: 150-200 yards. Tide: low. Depth of capture: 0-3'. Depth of water: 1-3'. Method of capture: dipnets, spears, lanterns. Collected by: Tetohu, Peni, Paulo, R. Harry. 136 specimens of 19 species.

Station 28.--Raroia; "Ohava" coral head in lagoon $\frac{1}{2}$ mile east of Garumaoa Village, west side of atoll, July 23. Vegetation: encrusting algae. Time: 8:30-11 A.M., 2:30-4 P.M. Bottom: coral, sand. Shore: sand. Current: app. 1 knot. Distance from shore: $\frac{1}{2}$ mile. Tide: between low and high. Depth of capture: 0-50'. Depth of water: 2-50'. Method of capture: rotenone (40 lbs.) and dipnets, spears. Collected by: Tetohu, Peni, Paulo, Kehea, Vaia, R. Harry, Approx. 500 specimens, 65 species.

Station 29.--Raroia; sand channel, vicinity of Tetou Islet, east side of atoll, July 23. Vegetation: none. Time: morning. Bottom: sand. Shore: sand. Current: app. 1 knot. Distance from shore: 50 yards. Depth of capture: 4'. Depth of water: 6'. Method of capture: spears, Collected by: expedition party. One Caranx armatus.

.--Raroia; outer reef flat at Kon-Tiki Islet, east side of atoll, July 23. Vegetation: encrusting algae. Time: morning. Bottom: beachrock, coral. Shore: beachrock, gravel. Current: app. 2 knots. Distance from shore: app. 75 yards. Depth of capture: 1'. Depth of water: 1'. Method of capture: spear. Collected by: expedition party. One Eulamia melanoptera.

Station 30.--Raroia; in lagoon near jetty of Garumaoa Village, west side of atoll, July 23. Time: 4-5 P.M. Bottom: sand, coral. Shore: sand. Current: app. 2 knots. Distance from shore: app. 200'. Tide: high. Depth of capture: 4'. Depth of water: 4'. Method of capture: spears. Collected by: natives, R. Harry. 2 specimens, 2 species.

Station 31.--Raroia; Garue Pass, west side of atoll, July 24. Time: 9 A.M.-5 P.M. Bottom: coral, gravel, sand. Shore: beachrock. Distance from shore: $\frac{1}{4}$ mile. Depth of capture: 20-40'. Depth of water: 30-40'. Method of capture: hook and line, spears. Collected by: Paulo, R. Harry. 29 specimens of 10 species.

Station 32.--Raroia; in lagoon at end of pier, Garumaoa Village, west side of atoll, July 22-24. Vegetation: encrusting algae. Time: continuous 2 days. Bottom: sand. Shore: sand. Current: none. Distance from shore: App. 200'. Depth of capture: 15'. Depth of water: 15'. Method of capture: plastic screen trap. Collected by: R. Harry. 2 Aulostomus chinensis.

Station 33.--Raroia; Garue Pass and immediate vicinity, west side of atoll, July 25, Aug. 1, Aug. 14, Aug. 15. Bottom: coral, gravel, sand. Shore: beachrock. Current: 1-8 knots. Distance from shore: $\frac{1}{4}$-$\frac{1}{2}$ mile. Depth of capture: 10-45'. Depth of water: 10-100'. Method of capture: hook and line, spears. Collected by: natives, R. Harry. 100 specimens of 48 species.

Station 34.--Raroia; outer reefs of Namunamukona Islet on northwest side of atoll, July 26. Vegetation: encrusting algae. Time: 12-1 P.M. Bottom: beachrock. Shore: beachrock. Current: 0-10 knots. Distance from shore: 50-100'. Tide: low. Depth of capture: 0-2'. Depth of water: 2'. Method of capture: spears and hands. Collected by: Hure, Rago, R. Harry. 3 specimens of 3 species.

Station 35.--Raroia; lagoon and outer reefs of Hava Islet, northeast side of atoll, July 27. Vegetation: encrusting and free growing algae. Time: 10-12 A.M. Bottom: rock, gravel, coral. Shore: gravel. Current: none. Distance from shore: 15-30'. Tide: between low and high. Depth of capture: 0-15'. Depth of water: 5-15'. Method of capture: rotenone (app. 16 lbs.) and dipnets. Collected by: Huri, Rago, Rairai, Kore, R. Harry. 52 specimens of 14 species.

Station 36.--Raroia; coral head in lagoon channel of Tapoki Islet, northeast side of atoll, July 28. Vegetation: encrusting algae. Time: 1-2:30 P.M. Bottom: gravel. Shore: gravel. Current: app. 2 knots. Distance

from shore: 100'. Tide: low. Depth of capture: 4'. Depth of water: 7'. Method of capture: dipnets. Collected by: Hure, Rairai, Kore, R. Harry. One Ostracion lentiginosum.

Station 37.--Raroia; large submerged coral head 15' across in lagoon bay of Teuriamote Islet, north end of atoll, July 28. Vegetation: encrusting algae. Time: 2:30-4:30 P.M. Bottom: gravel, coral. Shore: gravel, sand. Current: very slight. Distance from shore: 0-20'. Tide: high. Depth of capture: 0-18'. Depth of water: 10-18'. Method of capture: rotenone (10 lbs.) and dipnets. Collected by: Huri, Rairai, Kore, R. Harry. 118 specimens of 43 species.

Station 38.--Raroia; large enclosed pool 100 x 40' on lagoon sand flat of Tikamiti Islet, north end of atoll, July 28. Vegetation: encrusting algae. Time: 6 A.M.-4:30 P.M. Bottom: thick layer of fine sediment. Shore: gravel, beachrock. Current: none. Distance from shore: 0-20'. Depth of capture: 10-15'. Depth of water: 10-15'. Method of capture: rotenone (5 lbs.) and dipnets. Collected by: Kore, Rairai, R. Harry. 82 specimens of 19 species.

Station 39.--Raroia; outer reef flat between lithothamnion ridge and shore of Teuriamote Islet, north end of atoll, July 28. Vegetation: encrusting algae. Time: 8:30-11 P.M. Bottom: beachrock, coral. Shore: beachrock, gravel. Current: 2-6 knots. Distance from shore: 50-100 yards. Tide: between low and high. Depth of capture: 1-2'. Depth of water: 1-2½'. Method of capture: dipnets and Coleman lanterns. Collected by: Kore, Rairai, R. Harry. 30 specimens of 2 species.

Station 40.--Raroia; enclosed brackish pond 100' diameter, lagoon side of Tikaheru Islet, north end of atoll, July 29. Time: 9-10:30 A.M. Water: murky, brackish, with marked thermal layering. Bottom: thick layer of fine sediment. Shore: beachrock, gravel. Current: none. Distance from shore: 0-50'. Depth of capture: 10-20'. Depth of water: 20'. Method of capture: spears. Collected by: Hure, R. Harry. 4 specimens of 1 species.

Station 41.--Raroia; "Tomogoru" coral head, 75' across its flat top 1' below the surface, near Tomogoru Channel, north end of atoll, July 29. Vegetation: encrusting and abundant free growing algae. Time: 10-12 A.M. Bottom: coral, sand. Shore: sand, beachrock. Current: none. Distance from shore: app. 1 mile. Depth of capture: app. 2-4'. Depth of water: 2-25'. Method of capture: dipnets. Collected by: R. Harry. 150 Spratelloides spp.

Station 42.--Raroia; Geogeo lagoon reefs at inner edge, south of Garumaoa Village, west side of atoll, July 31. Vegetation: encrusting and free growing algae. Time: 3-4 P.M. Bottom: sand coral. Shore: sand. Current: very slight. Distance from shore: app. 3/4 mile. Depth of capture: 5-25'. Depth of water: 25'. Method of capture: rotenone (21 lbs.) dipnets, diving gear. Collected by: Rago, Rairai, Kore, J. Byrne, R. Harry. 140 specimens of 42 species.

Station 43.--Raroia; "Motoko" coral head in lagoon 1½ miles east of Tetataga Islet, west side of atoll, Aug. 2. Vegetation: dense free growing algal growth. Time: 12-3:30 P.M. Bottom: coral, sand. Current: app. 1 knot. Distance from shore: app. 1½ miles. Tide: high. Depth of capture: 12-30'. Depth of water: 2-40'. Method of capture: hook and line, spears. Collected by: Hure, Rago, R. Harry. 11 specimens of 3 species.

Station 44.--Raroia; outer reef flat near Oneroa Village, southwest side of atoll, Aug. 2. Vegetation: encrusting algae. Time: 9:30-11:45 A.M. Bottom: rock, gravel, coral. Shore: beachrock. Current: surge, strong. Distance from shore: 10-20'. Tide: high. Depth of capture: 0-2'. Depth of water: 2'. Method of capture: spears. Collected by: Rago, R. Harry. 6 specimens, 6 species.

Station 45.--Raroia; outer reef flat and surge channels near Oneroa Village, southwest side of atoll, Aug. 4-8. Vegetation: encrusting and some free growing algae. Time: day and night, app. 6 hours per day. Bottom: coral, beachrock. Shore: beachrock. Current: 0-strong surge. Distance from shore: app. 100 yards. Tide: low. Depth of capture: 10-30'. Depth of water: 10-30'. Method of capture: rotenone (app. 75 lbs.), dipnets, spears, diving gear. Collected by: expedition personnel. App. 1000 specimens of 75 species.

Station 46.--Raroia; large coral head app. 2 kilometers from the east and south sides of the atoll, Aug. 5. Vegetation: abundant encrusting and great clumps of free growing algae. Time: 9-10 A.M. Bottom: coral. Shore: sand, coral. Current: app. ½ knot. Distance from shore: 2 kilometers. Tide: high. Depth of capture: 1-15'. Depth of water: 2-30'. Method of capture: spears. Collected by: Huri, Rago, R. Harry. 6 specimens of 3 species.

Station 47.--Raroia; gravel and sand channels at extreme southern end of atoll, Aug. 5. Vegetation: encrusting algae. Time: 11 A.M.-3 P.M. Bottom: coral, sand, gravel, beachrock. Shore: gravel. Current: 0-8 knots. Distance from shore: 1-4 kilometers. Depth of capture: 5-10'. Depth of water: 10-15'. Method of capture: spears. Collected by: Huri, Rago, Kore, R. Harry. 39 specimens of 17 species.

Station 48.--Raroia; shore reefs in lagoon on submerged coral heads, in region of Rotava Korereka Islet, north end of atoll, Aug. 5-7. Vegetation: practically none. Time: day and night, app. 15 hours. Bottom: sand, coral. Shore: sand. Current: none. Distance from shore: 50-100 yards. Depth of capture: 5-20'. Depth of water: 10-20'. Method of capture: rotenone (app. 20 lbs.) and dipnets. Collected by: Kore, Rairai, Huri, R. Harry. 160 specimens, 30 species.

Station 49.--Raroia; "Vera Vera" coral head in lagoon app. 3 kilometers east of Oneroa Village, south west side of atoll, Aug. 8. Vegetation: abundant encrusting and free growing algae. Time: 9:30-11:30 A.M. Bottom: coral, sand. Shore: sand, gravel. Current: none. Distance

from shore: app. 3 kilometers. Tide: low. Depth of capture: 5-10'. Depth of water: 2-40'. Method of capture: rotenone (app. 15 lbs.) and dipnets. Collected by: Kore, Rago, R. Harry. 68 specimens of 23 species.

Station 50.--Raroia; lagoon reefs at Oneroa Village, southwest side of atoll, Aug. 9. Vegetation: encrusting algae. Time: 9:30-10:30 A.M. Bottom: coral. Shore: sand. Current: app. $\frac{1}{2}$ knot. Distance from shore: app. $\frac{1}{4}$ mile. Tide: low. Depth of capture: 0-4'. Depth of water: 3-4'. Method of capture: rotenone (app. 10 lbs.) and dipnets. Collected by: Rairai, Kore, R. Harry. 17 specimens of 7 species.

Station 51.--Raroia; lagoon reefs, Teputaiti Islet, south of Garumaoa Village, west of atoll, Aug. 9. Vegetation: encrusting algae. Time: 11:30-1:30. Bottom: coral, sand. Shore: sand. Current: none. Distance from shore: 0-100 yards. Depth of capture: 6-10'. Method of capture: spears. Collected by: Etienne for R. Harry. 2 specimens of 2 species.

Station 52.--Raroia; outer reef channels of Kahogi Islet, north of Garue Pass, west side of atoll, Aug. 10. Vegetation: encrusting algae. Time: 3:30-5 P.M. Bottom: beachrock, coral. Shore: beachrock. Current: 1-4 knots. Distance from shore: 50-100 yards. Depth of capture: 5-15'. Depth of water: 10-18'. Method of capture: spears, hook and line. Collected by: Rairai, Kore, R. Harry. 13 specimens of 10 species.

Station 53.--Raroia; vicinity of "Oreti" coral head, app. 3/4 mile northeast of Garumaoa Village, west side of atoll, Aug. 12. Time: morning. Bottom: sand, coral. Shore: sand, gravel. Current: none. Distance from shore: app. 3/4 mile. Depth of capture: app. 40'. Depth of water: app. 40'. Method of capture: deeper water dredging in lagoon. Collected by: J. Newhouse for R. Harry. One specimen of Eviota sp. 2.

Station 54.--Raroia; shore reefs in lagoon at Takeke Islet next to Garue Pass, west side of atoll, Aug. 12. Vegetation: encrusting algae. Time: 8-12 A.M., 1:30-5 P.M. Bottom: coral, sand. Shore: gravel. Current: none. Distance from shore: 5-100'. Depth of capture: 2-40'. Depth of water: 4-40'. Method of capture: spears, dipnets. Collected by: Rairai, Kore, Kehea, Vaia, R. Harry. 75 specimens of 6 species.

Station 55.--Raroia; lagoon and outer shore reefs at Tenukuhaupapatea (Fakatomo) Islet, immediately north of Garue Pass, west side of atoll, Aug. 12. Vegetation: encrusting algae. Time: 9:30 A.M.-3:30 P.M. Bottom: coral, beachrock. Shore: beachrock, gravel. Current: 0-3 knots. Distance from shore: 10-100 yards. Depth of capture: 3-10'. Depth of water: 3-15'. Method of capture: spears, dipnets. Collected by: Rairai and Kore for R. Harry. 18 specimens of 10 species.

Station 56.--Raroia; Garue Pass, west side of atoll, Aug. 13. Vegetation: abundant encrusting and free growing algae. Time: 5:30-7:30 P.M. Bottom: coral, sand. Shore: beachrock. Current: 2-10 knots. Distance from shore: 300 yards. Depth of capture: 10-20'. Depth of water: 30-40'. Method of capture: hook and line, trolling. Collected by: Kore for R. Harry. 2 specimens of 2 species.

Station 57.--Raroia; lagoon reef channels of Kumekume Islet south of Garue Pass, west side of atoll, Aug. 13. Vegetation: encrusting algae. Time: 9:30 A.M.-3 P.M. Bottom: coral, sand. Shore: beachrock, gravel. Current: slight. Distance from shore: 50-100 yards. Depth of capture: 2-6'. Depth of water: 2-6'. Method of capture: rotenone (app. 10 lbs.). Collected by Kore and Rairai for R. Harry. 70 specimens of 35 species.

Station 58.--Raroia; outer reef channels next to lithothamnion ridge next to Garumaoa Village, west side of atoll, Aug. 15. Vegetation: encrusting algae. Time: 9:20-11:45 A.M., 1:30-6 P.M. Bottom: beachrock, gravel. Shore: beachrock. Current: surge. Distance from shore: 100 yards. Depth of capture: 0-20'. Depth of water: 4-20'. Method of capture: rotenone (20 lbs.) and dipnets. Collected by: Kore, Rairai, Tetohu, R. Harry. 600 specimens of 75 species.

Station 59.--Raroia; first transect, outer reef surge channels at lithothamnion ridge, immediately south of excurrent channel, Aug. 17. Vegetation: encrusting algae. Time: 9-11:30 A.M. Bottom: beachrock, gravel. Shore: beachrock. Current: surge, turbulent breakers. Distance from shore: app. 150 yards. Tide: low. Depth of capture: 0-20'. Depth of water: 4-20'. Method of capture: rotenone (22 lbs.) and dipnets. Collected by: Tetohu, Rairai, Kore, R. Harry. 350 specimens of 40 species.

Station 60.--Raroia; lagoon reefs and channels of Teremu Islet, east side of atoll, Aug. 20-22. Vegetation: barren encrusting algae. Time: app. 18 hours. Bottom: sand, beachrock, coral. Shore: sand, beachrock. Current: 0-1 knot. Distance from shore: 0-$\frac{1}{2}$ mile. Depth of capture: 3-35'. Depth of water: 0-35'. Method of capture: hook and line. Collected by: Rairai, Kore, Huri, R. Harry. 91 specimens of 32 species.

Station 61.--Raroia; coral head $\frac{1}{2}$ mile off Teremu in lagoon, east side of atoll, Aug. 21. Vegetation: barren encrusting algae. Time: 1-4 P.M. Bottom: sand, coral, staghorn prominent. Shore: sand. Current: none. Distance from shore: $\frac{1}{2}$ mile. Tide: low. Depth of capture: 0-25'. Depth of water: 2-25'. Method of capture: rotenone (30 lbs.) and dipnets. Collected by: Kore, Rairai, Huri, R. Harry. 448 specimens of 54 species.

Station 62.--Raroia; app. $\frac{1}{4}$ mile off outer west coast of atoll between Garue Pass and Garumaoa Village, Aug. 25, 27. Time: 8:30 A.M.-3:30 P.M. each day. Bottom: coral. Shore: beachrock. Current: slight.

Distance from shore: app. ¼ mile. Depth of capture: 2-40'. Depth of water: 40-100'. Method of capture: hook and lines, trolling, hand-lines. Collected by: Kore, Rairai, for R. Harry. 24 specimens of 11 species.

Station 63.--Raroia; inner lagoon reef next to Kahuruna Islet, southeast side of atoll, Aug. 26. Vegetation: sparse encrusting algae. Time: 3:30 P.M. Bottom: sand, coral. Shore: gravel. Distance from shore: 100'. Depth of capture: 8'. Depth of water: 10'. Method of capture: spear. Collected by: Kehea for R. Harry. One specimen of Lutjanus bohar.

Station 64.--Raroia; lagoon shore reef of Rare Islet, west side of atoll, Aug. 27. Vegetation: encrusting algae. Time: 11 A.M. Bottom: coral, Shore: gravel. Current: none. Distance from shore: 50'. Depth of capture: 10'. Depth of water: 12'. Method of capture: spear. Collected by: Huri for R. Harry. One specimen of Siganus sp.

Station 65.--Raroia; channels at south end of atoll, Aug. 28. Vegetation: sparse encrusting algae. Time: 1-3:30 P.M. Bottom: sand, coral. Shore: sand, gravel. Current: app. 1-2 knots. Distance from shore: app. 100 yards. Depth of capture: 0-10'. Depth of water: 10'. Method of capture: rotenone (app. 10 lbs.) and dipnets. Collected by: Kore for R. Harry. 150 specimens, 45 species.

Station 66.--Raroia; reefs in Garue Pass next to Takeke Islet, west side of atoll, Sept. 1. Vegetation: considerable encrusting and free growing algae. Time: 10 A.M.-1:30 P.M. Bottom: coral. Shore: gravel. Current: slight. Distance from shore: app. 100 yards. Tide: low. Depth of capture: 1-25'. Depth of water: 1-25'. Method of capture: rotenone (40 lbs.), dipnets and spears. Collected by: Kore, Rairai, Huri, Rago, and R. Harry. 340 specimens of 50 species.

Station 67.--Raroia; lagoon reef at Teputaiti Islet, south of Garumaoa Village, west side of atoll, Aug. 25. Vegetation: encrusting algae. Bottom: coral, sand. Shore: gravel. Currents: none. Distance from shore: 50 yards. Depth of capture: 12'. Depth of water: 15'. Method of capture: spear. Collected by: Huri for R. Harry. One specimen of Naso annulatus.

ECOLOGICAL SURVEY

Figures 3-7

While the general report of the Raroia team will consider the marine ecology of this atoll on a broad biological basis, specific notes on the zonation of fishes are included in this section. A large proportion of the field time was involved in preparing the collection of fishes, taking kodachrome slides, and compiling notes on the colors of living fish. To a lesser extent habitat data were also recorded at the end of the time in Raroia and part of these notes are given in the systematic account. The present section was also prepared at the end of the Raroia study and is an attempt to give a general view of fish distribution on Raroia Atoll. Far more notes were taken than included here. So much was observed that was not understood that the confusing observations were deleted. It is hoped that more of the field data can be incorporated into the report of the next coral atoll project.

For convenience the marine environment of the atoll has been divided into eight major zones which are as clearly delimited ecologically as they are physically. These zones can be considerably subdivided on the basis of fish associations and habitats and most of this phase will be considered in the general ecological report.

Coralliferous Outer Bench: This region is defined by Cloud (1952). It extends from the steep outer slope to the surge channel buttresses. The greatest growth of coral at Raroia is in this region and a large percentage of the total fish fauna lives on this shelf. Sharks constantly patrol this area, apparently continually circling the atoll looking for food. Tuna, barracuda and jacks also scout these waters, but normally keep nearer the surface. Larger sea basses are in greater abundance in this zone (as are also the previous fishes mentioned) than anywhere else on the atoll and seem to hide in every hole in the coral. Naso and Balistes are evident immediately above the coral and various species of the demoiselles that penetrate to deeper water (e.g. Dascyllus) form clouds around the coral. The extent of the fish fauna can best be seen by dropping balls of rotenone mud onto the coral. About twice as many fishes as would be seen around a lagoon coral head boil out of holes in the coral when rotenone takes effect. Several times I talked myself into chancing encounters with sharks to collect in this region, but the natives forcibly refused to let me go in the water, talking as if it would be sure death. Without a doubt the finest fish collections at Raroia could be taken on this shelf, and very easily on the west side of the atoll, if it were not for the sharks. While this zone seemed to be relatively the same on the east and west side of the atoll, it seemed definitely shorter on the east side. Practically all observations were made on the west side.

This region has a very characteristic fauna, typified by several sharks and carangids not observed elsewhere around the atoll. At the surface are particularly Sphyraena, thunnids, and schools of Hemirhamphus. At mid-depths are small schools of carangids. Immediately above the coral sharks wander about, passing from one surge channel to the next; none larger than 12 feet were seen and they would average about 5-6 feet in length. Remaining rela-

tively motionless above the coral are mostly Balistes, Naso and often Acanthurus. Only very small fishes, such as Dascyllus, Labroides and Halichoeres, would be seen about the coral. When this region was poisoned great numbers of small coral reef fishes less than five inches long (such as blennies, gobies, a few cirrhitids and a large number of wrasses) came out of hiding, along with large sea basses one to three feet long. Conspicuous by their complete absence were chaetodontids, and holocentrids. Parrot fishes were also uncommon in this region.

Surge Channels: This term is defined by Cloud (1952), and comprises the next region inward toward the shore between the coralliferous outer bench and the coralline ridge. This zone consists of deeply grooved troughs that have wide outer mouths approximately 25-35' deep and narrow dead ends at the ridge. It is continuous around the atoll and is complexly developed on the southeastern side in the region of Oneroa. The entire lengths of these troughs were collected at several localities on the west side of the atoll. Since it was dangerous collecting in the open mouths because of the sharks, less is known of this outer area. Twice I was rushed by sharks in the outer zone and the Raroians completely refused to dive there.

The surge channels contain the most distinctive fish fauna of any zone at Raroia. Many species are completely limited to them and many fishes found just about everywhere else on the atoll do not occur in these surge channels. The zone is completely dominated by cirrhitids and blennies (especially the genus Cirripectes), although none can be seen when casually observing the channels. In fact during the day they look practically barren except for sharks, scarids and carangids schooling in the outer mouths. However, when rotenone is thrown into the troughs, the waves swirl it quickly from one end to the other and the fishes immediately succumb and are swept out of their hiding places from under rocks and from cracks in the buttress walls. The fishes in this region apparently have a high respiratory rate because of the heavy surf action with high oxygen concentration. As a result the entire fish fauna of the troughs completely succumb to rotenone laden waves in a few minutes. No where else did we obtain such complete collections of a particular habitat. Also, wave action tended to sweep fishes out into the open and into pockets on the bottom, making observations on relative abundance and collecting much easier. Sharks were constantly attracted to collecting stations, although they never paid any attention to the fishes, living or dead. They were, however, quite interested in the swimmers.

Aside from the blennies and cirrhitids, the narrow end of the channels have a large population of small echidnid eels, most of which are limited to this region and the sea urchin holes on the coralline ridge. Two pomacentrids are confined entirely to the channels, several scorpaenids are moderately abundant in the surge channels and in the sea urchin holes on the coralline ridge, and brotulids are prominent under the rocks and in the holes. The broader, deeper section next to the outer mouth supports a good sized population of larger fishes, consisting primarily of surgeon fishes, cirrhitids, carangids, scarids, and to a lesser extent labrids, none of which are confined to the surge channel zone. Few smaller fishes are found in this distinctive subzone.

At high tide large fishes move in from the surge channel mouths and coralliferous outer bench and congregate in the narrow ends. Many species, as typified by Acanthurus guttatus and Acanthurus achilles, move out of the channels onto the reef flat.

At night the surge channels at high or low tide are teaming with fishes, particularly holocentrids. The nocturnal Cirripectes and cirrhitids are very much in evidence and even at low tide are found climbing about out of water on the coralline ridge. Schools of Monotaxis congregate in the channels and pass onto the reef flat at high tide as do the holocentrids.

Coralline Ridge: This zone is discussed by Cloud (1952) and consists of the high ridge formed by coralline algae between the surge channels and outer reef flat extending to shore. Usually its outer and inner face is honeycombed with sea urchin holes, which considering their size, support an amazingly large fish population. Its outer face supports the same fish fauna as the inner ends of the surge channels; it is dominated by small echidnid eels, and to a lesser extent cirrhitids. Some Cirripectes also live in the sea urchin holes, but not many are found during the day. The top of the ridge usually offers no hiding place for fish, although it is notable as a feeding ground for parrot fish at high tide. The inner face and outer part of the reef flat (termed "back ridge trough of outer reef flat" by Cloud, 1952) are usually heavily honeycombed by sea urchin holes and support a small distinctive fish fauna entirely different from the other reef zones. It is dominated by the pomacentrid Abudefduf imparipennis and is inhabited by several small scorpaenids not found elsewhere. The genus Echidna was found here more than anywhere else and a few of the other "surge channel" echidnid eels also range back to this subzone. A few small apogonids are also distinctive to this region. The gobies of the genera Gobiodon and Paragobiodon are fairly common, although not at all as abundant as in the next zone toward shore; in some sections of the atoll they did not invade this zone at all.

At night at high tide this region is dominated by cirrhitids and holocentrids, which congregate in this zone more than anywhere else on the reef flat. Cirripectes is also common here, and many echidnid eels move out of the surge channels onto this zone searching for food.

Outer reef flat: This region, according to currently accepted definition (see Cloud, 1952) extends from the coralline ridge to shore. On the basis of fish associations, it can be divided into three zones: an outer area packed with sea urchin holes ("back ridge trough" of Cloud, 1952). Since the outer zone has already been discussed in the previous section, we will go on to the middle subzone. At low tide this is characterized by great numbers of gobies of the genera Paragobiodon and Gobiodon. To a lesser extent both species of Caracanthus are prominent. Moderate numbers of small labrids (usually Halichoeres) and Tetraodon hide among the coral. Lycodontis picta wanders into this region but definitely belongs in the tide pool zone.

At high tide day and night great numbers of larger fishes come over the reef flat to feed. During the day the prominent groups are Eulamia melanoptera,

surgeon fishes (especially Acanthurus triostegus, A. guttatus and A. achilles), wrasses (Thalassoma and Halichoeres primarily), many species of parrot fishes, and chaetodontids. At night the fish fauna consists of Holocentrids (mostly Holocentrus), mugilids, Belone, Hemirhamphus, Monotaxis and a few cirrhitids. So far as the collections have been studied this subzone contains no species known only from this region, but the quality of its fish fauna was found no where else.

The final tidepool subzone is the most unique in fauna of the outer reef flat. It contains some blennies and gobies found nowhere else and is dominated by these two groups and the echidnid eels, Lycodontis picta and L. flavimarginata. The pomacentrid, Abudefduf glaucus, is prominent here as are young Cephalopholis argus. It is also typified by syngnathids which very rarely were observed elsewhere. At high tide the fauna of this zone spreads over the reef flat to feed but its own zone is not invaded by other larger fish.

Inter-Islet Channels: No zone is more variable at Raroia than the channels, varying from the deep west (Garue) Pass with one of the largest fish populations of any locality at this atoll to narrow closed off channels with meager faunas. The channels at Raroia can be broadly divided into four groups: Garue Pass--a main deep channel, South Pass--a broad shallow flat, and complete and incomplete inter-islet channels. There are over 250 channels, most of which are continuous from lagoon to outer reef at least at high tide.

Garue Pass is approximately 400 yards wide and about 40-60' deep. Most of the time there is a very strong flow of water out the Pass, but at extreme high tide the direction of the current reverses. Coral growth is very abundant in the Pass, especially on the shore reefs. This zone has by far the greatest concentration of fishes of any restricted locality at Raroia, and is the favorite fishing ground of the natives. All of the large fish groups are abundant here, particularly the families Galeorhinidae, Isuridae and Carangidae. Other families that are dominant are Echeneididae, Balistidae, Labridae, Scaridae, Serranidae, Lethrinidae, and Lutianidae. The shore reefs have a very distinctive fauna. Dascyllus trimaculatus, Acanthurus lineatus, Amphiprion bicinctus and large sea anemones apparently occur only in this zone at Raroia. Chaetodon reticulatus, C. ornatissimus and Acanthurus achilles are more abundant in the Pass than any other locality.

The Southern Pass is a broad rock and sand flat approximately four miles wide and not more than two feet deep at low tide at any place; at its highest ridge from Kakipuku to the first east islet near Kakuruna it probably averages less than 6" deep at low tide. There is a strong flow of water out at low tide (outside the lagoon) and a reversal of flow at high tide. There is moderate coral growth in the Pass. The only fishes in abundance over the flat are young Eulamia melanopterus, which swarm in great numbers over all the flat. Otherwise the fish fauna is sparse considering the large area involved. A few species of the families Labridae, Lutianidae, Serranidae and Chaetodontidae comprise a great percentage of the fish population in the Pass. Gobies, blennies and echidnids are moderately abundant in shallow protected pools on the flat. At the lagoon side of the Pass Diodon is fairly abundant (according to the natives), as are large serranids.

The inter-islet channels vary tremendously in fish population depending upon width, intermittent or continuous connection between lagoon and outer sea and position on the atoll. Also many of them are strongly affected by the extent of sand bars that are often at the lagoon entrances. The problems of the ecology of inter-islet channels were far from understood at Raroia and were so variable that it is difficult to see the overall picture. The shallow narrow continuous channels are generally characterized by large numbers of gobies and blennies, and even greater numbers of Abudefduf imparipennis. Parapercids are found only in this zone and the region is a nursery for the young of many species of echidnids, Epinephelus and Cephalopholis argus. The closed off channels are dominated by wrasses (the genus Stehojulis is most abundant in this habitat) and chaetodontids. Coral growth is sparse and where staghorn coral is present Dascyllus aruanus is moderately common.

Lagoon shore reef flat: On the west side of the atoll the lagoon shoreline is bordered by a flat topped reef that abruptly drops down 10-35 feet to sand bottom 5-1200 feet from shore. The top of the reef is covered with dead or sparsely growing coral that almost reaches the surface at low tide. The fish fauna of this region is limited and primarily consists of Acanthurus triostegus, Pomacentrus nigricans and moringuids. The fishes on the reef face wander over the reef top at high tide to feed, but generally keep out of this region at low tide. Individuals of Pomacentrus nigricans are restricted to definite coral heads or sections of coral heads, diving down among the coral branches when danger threatens. Acanthurus triostegus wander in large schools over the reef top. The two species of moringuids are abundant buried in the sand to a depth of at least two feet and are not seen except by using a rotenone ichthyocide.

The lagoon shoreline around the remainder of the atoll is almost entirely sand and gravel, gradually sloping to deep water. Schools of mullet and young Lutianus form the greatest percentage of the fish fauna in this area.

Lagoon Shore Reef Face: As mentioned under Reef Flat, the lagoon reef face is present only on the west side of the atoll. Its fish fauna is very similar to the neighboring lagoon coral heads, but does not include as many species. The coral growth is not as extensive on the reef face as on the coral heads except in Garue Pass. Much of the reef face is undercut as shown in figure 4, and often has deep clefts extending back into the reef, particularly in the region of Kukina Rua.

Large schools of scarids travel along the reef face feeding; occasionally groups of Naso and Caranx also do the same. The genera Synodus and Moringua noted on figure 4 remain buried in the sand about the base of the coral. Echelid eels also prefer this habitat, and remain buried vertically in the sand with only the head exposed.

Lagoon Coral Heads: The lagoon at Raroia is deep and has hundreds of coral heads (or patch reefs) relatively evenly situated throughout. These coral heads have steep sides and flat tops and almost reach the surface at low tide (see figure 7). Most of them are elongate in lateral cross section and the

direction in which they are oriented depends upon their position in the lagoon and the prevailing current direction. The majority of coral heads are pointed towards the east or north east. The marine life on a coral head varies trenchantly depending upon the reef's position in the lagoon. A summary of the typical conditions for a western coral head near Garumaoa is presented in figure 7. Coral heads situated on the east and northeast sides of the lagoon have a considerably reduced fauna than elsewhere. The coral heads in the southwest region of the lagoon have the greatest variety of fishes, although the coral heads on the west side between Garue Pass and Kukina Rua seem to have the largest populations.

The open lagoon appears to have a relatively restricted fish population. Small gobies were brought up in bottom dredges down to 40 feet, but no other fishes. Sharks, carangids and Spratelloides are very likely the dominant open water groups. Near the coral heads and shore reef schools of large parrot fishes seem slowly to follow definite paths like cattle. The eastern sand flats are particularly inhabited by mantas, eagle rays and sting rays.

SYSTEMATIC ACCOUNT

Historical Introduction

Despite the fact that all past expeditions have spent only a few days collecting fishes in the Tuamotu Archipelago, approximately 286 species of fishes have been amassed. Our knowledge of the fish fauna is primarily known from ten expeditions and small scattered collections; most important are the Andrew Garrett collections, the "Albatross" Expeditions of 1899-1900 and 1904-1905, the Crane Pacific Expedition of 1928 and the George Vanderbilt South Pacific Expedition of 1937. No fishes have been recorded in the literature from Raroia Atoll; the closest island where fishes have been reported is Makemo, approximately 50 miles to the west of Raroia. Definite locality records are known for 20 of the 80 islands within the Tuamotus.

Because of the hostility of the natives, the early scientific expeditions to the Tuamotus during the first half of the nineteenth century were not able to collect fishes on any of the eastern islands, and had difficulties on the western atolls. The first fish described from the Tuamotus appears to be Chaetodon vinctus [= Chaetodon bennetti Cuvier] by Lay and Bennett (1839) collected from Byam Martin [Vairaatea] Island, by the voyage of the "Blossom" under the command of Captain F. W. Beechey in the years 1825-1828.

The earliest collections of fishes made in the Tuamotus were apparently taken by the Wilkes Exploring Expedition of the U. S. Navy, 1838-1842. The fishes were originally to have been reported upon in two volumes by Louis Agassiz and many hundreds of illustrations were prepared under his direction. The manuscript (which Wilkes estimated would amount to over 2,000 printed pages) was never completed or published, although Agassiz hoped to present in this work an entirely new classification of fishes and to change radically the principles for defining fish families. The fishes and illustrations were turned over to Henry W. Fowler at the Academy of Natural Sciences of Philadelphia in 1920 by the U. S. National Museum with the request that a report be prepared. By that time many fishes and labels had been lost, and many specimens were in poor condition. Fowler and Bean (1923) reported on the new species, including one wrasse from the Tuamotus. Fowler (1940) presented a check list of the entire collection, including 15 species from the "Tuamotus," Lazareff I., and Clermont de Tonnier I.

The most important nineteenth century contribution to our knowledge of Tuamotuan fishes were the publications of Günther (1873-1875) on Andrew Garrett's Fische der Südsee. Fifty-four species were described from the "Tuamotus;" only one was recorded from a definite locality. Native names were noted for a few species.

The next addition is by Vaillant (1887) who records 11 species with native names from Rikitea of Mangareva, Rangiroa, S. Marutea and "Tuamotus," which had been collected by the ship "Volage" in 1883 and 1884.

Günther (1887) in the Challenger Expedition deep sea fish report notes Malacosarcus macrostoma from near the Tuamotus, but apparently had no other fishes from this area.

The largest collection of fishes from the Tuamotus other than that later obtained by George Vanderbilt was collected by the "Albatross" Expedition of 1899-1900 under the charge of Alexander Agassiz. The shore fish report by Kendall and Goldsborough (1911) includes 93 species (one described as new) from the Tuamotu islands: Anaa, Fakarava, Makatea, Makemo, Pinaki, Rangiroa, Whitsunday and Tikei.

About the same time as this "Albatross" expedition, Alvin Seale was collecting fishes in southern Oceania for the Bishop Museum (1900-1903). He prepared a collection of 38 species from Makatea and Mangareva in the Tuamotus, three of which he described as new (Seale, 1906).

The "Albatross" Expedition of 1904-1905 under the charge of Alexander Agassiz collected fishes in Port Rikitea and on the outer reef of Mangareva Island, Tuamotus. Kendall and Radcliffe (1912) described this collection which comprised 42 species.

Regan (1917, p.391) records Harengula punctata Cuvier and Valenciennes from the "Tuamotu Archipelago." The Whitney South Sea Expedition 1920-1925 under the auspices of the American Museum of Natural History collected at twelve islands in the Tuamotus, although only a few fishes were taken. Nichols (1923) reported on these fishes and recorded five species from Mangareva and Marutea, two of which he described as new genera and species. Weber and de Beaufort (1922, 1931) record 13 species from the "Tuamotus" without definite locality records. The Templeton Crocker Expedition of 1934-1935 on the "Zaca" through the eastern Pacific under the auspices of the American Museum of Natural History also made a small fish collection; Nichols and Breder (1935) described a new species of flying fish from Nengo Nengo and Tatakoto, but otherwise the collection is apparently not published.

Fowler in his "Fishes of Oceania" (1928, 1931, 1934, 1949) includes many of the previous records from the Tuamotus and a few new ones which are summarized in his 1938 check list at the end of the Vanderbilt Expedition Report.

The Crane Pacific Expedition of 1928 made short stops in the Tuamotus at Takaroa and Makatea. Herre (1935, 1936) reported upon the 42 species collected at these islands, two of which he described as new.

Giltay (1939) reported upon the fishes collected by the cruises of the Belgian naval school vessel "Mercator" in 1934-1935. Ten species were recorded from Fakarava in the Tuamotus.

The largest collections taken in the Tuamotus are those of the George Vanderbilt South Pacific Expedition of 1937, personally obtained by Mr. Vanderbilt. In seven days collecting at Takaroa, Apataki and Rangiroa over 156 species were obtained. Fowler (1938, 1953) reported on this material, describing the fishes from each locality separately.

A summary of all the Tuamotu records is presented in the following check list, which uses Fowler's 1938 classification for convenience. This list will be considerably revised and expanded when the Raroia and Takume material is studied. Note the "Check List of the Islands of the Tuamotu Archipelago" later in this report for location and synonymy of the atolls.

Tentative Check List of Fishes Previously Recorded from Tuamotus

Table 1

	AKIAKI I.	ANAA I.	ARUTAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI	VAIRAATEA
Eulamia melanoptera (Quoy & Gaimard)				x										x		
Elops machnata (Forskål)												x				
Chanos chanos (Forskål)								x								
Stolephorus delicatulus (Bennett)			x								x			x		
Harengula punctata (Rüppell)														x		
Leptocephalus accipiter Fowler												x				
Muraenichthys schultzei Bleeker			x													
Muraenichthys macropterus Bleeker											x					
Muraenichthys retropinnis Fowler											x					
Myrichthys colubrinus (Boddaert)			x													
Machaerenchelys vanderbilti Fowler												x				
Ophichthus vanderbilti Fowler												x				
Rataboura javanica (Kaup)														x		
Echidna polyzona (Richardson)														x		

	NENGONENGO I.	TATAKOTO I.	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	MARUTEA I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIHAATEA I.
Lycodontis picta (Ahl)					x		x							x		x		
" meleagris (Shaw & Nodder)														x		x		
" ruppelliae (McClelland)													x			x		
" flavo marginata (Rüppell)														x				
" undulata (Lacépède)			x			x								x				
" favaginea (Schneider)																		
Enchelynassa canina (Quoy and Gaimard)						x												
Uropterygius concolor Rüppell													x					
" macrocephalus (Bleeker)						x												
" marmoratus (Lacépède)						x				x								
Synodus japonicus (Houttuyn)							x									x		
Saurida gracilis (Quoy & Gaimard)										x			x	x				
Belone platyura Bennett					x									x				
Strongylura indica (Le Sueur)					x													
Hyporhamphus acutus (Günther)					x									x				
Rhynchorhamphus georgii (Valenciennes)														x				
Hemirhamphus erythrorinchus Le Sueur						x												
Cypselurus atrisignis Jenkins																x		
" angusticepts Nichols and Breder	x	x																

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	MARUTEA I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Cypselurus simus (Valenciennes)										x						
Bregmaceros mcclellandii Thompson											x					
Bothus mancus (Broussonet)			x	x			x	x				x				
" constellatus (Jordan & Goss)					x											
" pantherinus (Rüppell)				x		x		x				x				
Malacosarcus macrostoma (Günther)														x		
Anomalops katoptron (Bleeker)														x		
Holocentrus caudimaculatus Rüppell												x				
" ruber (Forskål)			x													
" erythraeus Günther														x		
" lacteo-guttatus Cuvier							x	x				x				
" diadema Lacépède				x					x		x	x				
" microstomus Günther			x				x					x		x		
" spinifer (Forskål)			x					x	x			x				
" sammara (Forskål)			x	x				x	x			x		x		
" opercularis Valenciennes			x						x					x		
Myripristis murdjan (Forskål)			x								x	x		x		
" undecimalis Herre												x		x		
" violaceus Bleeker			x													
" microphthalmus Bleeker									x					x		

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Myripristis pralinius Cuvier			x						x							
Corythoichthys conspicillatus (Jenyns)														x		
Aulostomus chinensis (Linnaeus)			x									x		x		
Fistularia petimba Lacépède			x	x			x	x			x	x		x		
Atherina temminckii Bleeker											x					
" vaigiensis (Quoy & Gaimard)								x								
Mugil tade Forskål			x								x					
" longimanus Günther			x													
" vaigiensis Quoy & Gaimard			x					x			x	x		x		
" macrolepis Andrew Smith							x	x								
" crenilabis Forskål			x					x						x		
Myxus leuciscus Günther							x									
Neomyxus chaptalii (Eydoux and Souleyet)			x					x	x							
Sphyraena barracuda (Walbaum)												x				
" obtusata Cuvier												x				
Parathunnus sibi (Schlegel)						x										
Acanthocybium solandri (Cuvier)	x													x	x	
Gempylus serpens Cuvier														x		
Coryphaena hippurus Linnaeus														x		
Nomeus gronovii (Gmelin)														x		

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Scomberoides toloo-parah (Rüppell)											x					
" sancti-petri (Cuvier)			x													
Decapterus pinnulatus (Eydoux & Souleyet)									x							
Selar crumenophthalmus (Bloch)				x							x	x				
Caranx stellatus Eydoux & Souleyet									x			x				
Carangoides ferdau (Forskål)								x								
" gymonstethoides Bleeker												x				
Trachinotus baillonii (Lacépède)									x							
Amia bandanensis (Bleeker)							x		x							
" aroubiensis (Hombron and Jacquinot)									x							
" fraenata (Valenciennes)								x	x			x		x		
" hypselonotus (Bleeker)									x							
" erythrina (Snyder)									x							
Apogonichthys auritus (Valenciennes)									x							
Cheilodipterus lineatus (Linnaeus)									x							
" quinquelineatus Cuvier														x		
Dules rupestris (Lacépède)														x		
" marginatus Cuvier														x		
" sandvicensis (Steindachner)							x	x	x							

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Plectropomus maculatus (Bloch)			x											x		
Variola louti (Forskål)														x		
Cephalopholis argus Schneider			x						x		x	x				
" urodelus (Schneider)									x			x		x		
" sexmaculatus (Rüppell)														x		
Serranus fasciatus (Forskål)									x					x		
" gilberti Richardson								x	x							
" corallicola Valenciennes							x		x							
" merra (Bloch)			x					x	x		x	x				
" socialis Günther									x					x		
" summana (Forskål)							x									
" fusco-guttatus (Forskål)			x					x			x	x		x		
Grammistes sexlineatus (Thunberg)														x		
Priacanthus hamrur (Forskål)												x				
Lutjanus kasmira (Forskål)									x							
" bohar (Forskål)			x											x		
" vaigiensis (Quoy & Gaimard)			x				x	x	x							
" gibbus (Forskål)			x	x				x			x					
" monostigma (Cuvier)		x					x	x				x		x		
Pterocaesio tile (Cuvier)									x							
Lethrinus mahsena (Forskål)			x						x					x		

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	S. MARUTEA I.	MANUTEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Lethrinus reticulatus Valenciennes														x		
" miniatus (Schneider)			x	x		x					x					
Pentapodus aureo-lineatus (Lacépède)			x						x					x		
Monotaxis grandoculis (Forskål)			x									x				
Mulloidichthys auriflamma (Forskål)			x					x	x		x	x				
" samoensis (Günther)			x	x				x	x		x	x				
Pseudupeneus trifasciatus (Lacépède)			x						x			x				
" barberinus (Lacépède)			x	x												
" crassilabris Valenciennes			x													
Paracirrhites hemistictus (Günther)												x				
" polystictus (Günther)														x		
Chaetodon ornatissimus Cuvier												x				
" pelewensis Kner														x		
" bennetti Cuvier										x		x		x		x
" trifasciatus Mungo Park			x	x					x			x				x
" ephippium Cuvier				x					x	x		x				
" citrinellus Cuvier														x		
" lunula (Lacépède)			x				x	x				x		x		
" reticulatus Cuvier												x				
" quadrimaculatus Gray			x				x									
" auriga Forskål			x					x								

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Chaetodon mertensii Cuvier														x		
" falcula Bloch			x								x	x				
" lineolatus Cuvier									x					x		
" trifascialis Quoy & Gaimard			x	x						x		x				x
Heniochus permutatus Cuvier									x					x		
" monocerus Cuvier									x			x		x		
Forcipiger longirostris (Broussonet)				x								x		x		
Pygoplites diacanthus (Boddaert)												x		x		
Pomacentrus imperator (Bloch)			x											x		
Centropyge flavissima (Cuvier)												x		x		
Zanclus cornutus (Linnaeus)												x				
" canescens (Linnaeus)											x					
Hepatus triostegus (Linnaeus)				x			x	x	x							
" guttatus (Schneider)			x	x							x					
" fuliginosus (Lesson)												x				
" elongatus (Lacépède)							x									
" lineatus (Linnaeus)												x				
" bleekeri (Günther)				x							x					
" olivaceus (Schneider)														x		
" nigricans (Linnaeus)														x		

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Hepatus glauco-pareius (Cuvier)			x									x				
" achilles (Shaw)			x				x					x				
Ctenochaetus flavicauda Fowler												x				
" strigosus (Bennett)									x							
Zebrasoma veliferum (Bloch)			x									x		x		
Laephichthys rostratus (Günther)			x													
Naso lituratus (Schneider)												x				
" eoume (Lesson)			x								x			x		
" brevirostris (Valenciennes)			x								x	x		x		
Siganus punctatus (Schneider)								x						x		
" rostratus (Valenciennes)								x	x							
Scorpaenopsis gibbosus (Schneider)			x											x		
Sebastapistes bynoensis (Richardson)								x								
Nemapterois biocellatus Fowler												x				
Pterois antennata (Bloch)							x									
" radiata (Cuvier)			x	x			x					x				
Synanceja verrucosa Schneider									x					x		
Caracanthus maculatus (Gray)											x	x		x		
" unipinna (Gray)								x								
Dactyloptena orientalis (Cuvier)														x		
Dascyllus trimaculatus (Rüppell)												x				

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Dascyllus aruanus (Linnaeus)				x					x			x		x		
Chromis caeruleus (Cuvier)				x					x					x		
Pomacentrus pavo (Bloch)								x				x		x		
" nigricans (Lacépède)							x	x				x				
Abudefduf saxatilis (Linnaeus)				x				x						x		
" coelestinus (Cuvier)				x				x						x		
" sordidus (Forskål)		x	x	x			x	x	x		x			x		
" septemfasciatus (Cuvier)			x	x			x	x	x			x				
" luecozonus (Bleeker)							x									
" biocellatus (Quoy & Gaimard)								x								
" glaucus (Cuvier)				x			x	x	x			x		x		
" leucopomus (Cuvier)							x									
" amabilis (De Vis)														x		
Lepidaplois axillaris (Bennett)														x		
" hirsutus (Lacépède)												x		x		
Epibulus insidiator (Pallas)				x								x				
Anampses geographicus Valenciennes														x		
" diadematus Rüppell														x		
Stethojulis strigiventer (Bennett)				x										x		
" axillaris (Quoy & Gaimard)											x					
Halichoeres centriquadrus (Lacépède)			x									x				

	MATAIVA	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Halichoeres trimaculatus (Quoy and Gaimard)					x				x								
Coris gaimard (Quoy and Gaimard)				x													
Thalassoma quinquevittatum (Lay and Bennett)													x		x		
" hardwicke (J. W. Bennett)													x				
" umbrostygma (Rüppell)								x									
" purpureum (Forskål)	x										x		x		x		
" trilobata (Lacépède)								x							x		
" lutescens (Lay & Bennett)										x							
Gomphosus tricolor (Quay & Gaimard)										x			x				
Pseudocheilinus hexataenia (Bleeker)													x				
Cheilinus trilobatus Lacépède										x							
" undulatus Rüppell												x	x		x		
" diagraminus (Lacépède)										x							
" chlorourus (Bloch)				x				x		x					x		
Callyodon perspicillatus (Steindachner)													x				
" sordidus (Forskål)								x					x		x		
" microcheilos (Bleeker)													x				
" microrhinos (Bleeker)										x			x				
" brevifilis (Günther)													x				

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Callyodon harid (Forskål)			x													
" pulchellus (Rüppell)				x												
" fasciatus (Valenciennes)			x									x				
" janthochir (Bleeker)														x		
" oviceps (Valenciennes)														x		
" blochii (Valenciennes)			x													
" rubroviolaceus (Bleeker)							x									
" macrocheilos (Bleeker)												x				
" nuchipunctatus (Valenciennes)												x				
Asterropterix semipunctatus (Rüppell)				x												
Eviota afelei Jordan & Seale												x				
" viridis (Waite)				x				x			x					
Ptereleotris microlepis (Bleeker)			x									x				
Diaphoroculius rangiroae Fowler											x					
Gobiodon rivulatus (Rüppell)				x										x		
Paragobiodon echinocephalus (Rüppell)				x				x			x	x				
Glossogobius biocellatus (Valenciennes)								x								
Gobius fuscus Rüppell							x	x	x		x					
Echeneis remora Linnaeus				x												
Leptecheneis naucrates (Linnaeus)				x				x	x			x		x		

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS"	VAHITAHI I.	VAIRAATEA I.
Callionymus cookii Günther				x										x		
Petroscirtes filamentosus (Valenciennes)														x		
" taeniatus (Quoy and Gaimard)														x		
Blennius tonganus Jordan & Seale												x		x		
Salarias edentulus (Schneider)				x			x	x	x		x			x		
" periophthalmus (Valenciennes)								x	x							
" biseriatus Valenciennes									x							
" meleagris Valenciennes							x									
" caudolineatus Günther							x				x					
" lineatus Valenciennes				x					x							
Enchelyurus ater Günther				x												
Brotula multibarbata Schlegel												x				
Balistes vidua Richardson			x									x				
" capistratus Shaw			x					x				x				
" bursa Schneider												x				
" flavimarginatus Rüppell												x				
" aculeatus (Linnaeus)			x				x				x	x				
Balistapus rectangulus (Schneider)														x		
" undulatus (Mungo Park)			x									x				
Melichthys buniva (Lacépède)														x		

	AKIAKI I.	ANAA I.	APATAKI I.	FAKARAVA I.	GAMBIER IS.	HITI I.	MAKATEA I.	MAKEMO I.	MANGAREVA I.	PINAKI I.	RANGIROA I.	TAKAROA I.	TIKEI I.	"TUAMOTUS""	VAHITAHI I.	VAIRAATEA I.
Cantherines pardalis (Rüppell)												x				
Amanses scopas (Cuvier)												x				
Ostracion cubicus Linnaeus									x			x				
" cornutus Linnaeus												x		x		
Canthigaster bennettii (Bleeker)				x												
" margaritatus (Rüppell)								x	x							
Tetrodon hispidus Linnaeus			x													
" meleagris Schneider				x				x	x			x	x	x		
Antennarius bigibbus Lacépède				x									x			

Table 2

Islands from which fishes have been previously recorded	Number of species of fishes recorded
Akiaki	1
Anaa	2
Apataki	74
Fakarava	48
Gambier Is.	3
Hiti	3
Makatea	33

Islands from which fishes have been previously recorded	Number of species of fishes recorded
Mataiva	1
Makemo	52
Mangareva	62
Marutea	1
Nengonengo	1
Pinaki	4
Rangiroa	50
S. Marutea	1
Takaroa	106
Tatakoto	1
Tikei	2
"Tuamotus"	101
Vahitahi	2
Vairaatea	3

Field Data of the Fishes Collected at Raroia

Approximately 400 species of fishes were collected at Raroia Atoll, but information of only about 300 was prepared in the field. The smallest specimens could not be identified or examined for lack of a microscope so that such groups as Blenniidae, Gobiidae, Labridae and Apogonidae are very incompletely recorded. Whenever possible, the species were identified, life colors recorded before preservation, and habitat and distribution noted. This information should be of value to future coral atoll teams and is presented in this section. The scientific names are all field identifications from inadequate literature, and must be confirmed; this section merely presents the extent of the work done. When the final report is prepared the deficiencies will be corrected. The subheading "stations" for each species presents the stations where it was collected (providing this was recorded in the field), and the number of specimens taken is indicated in parentheses after each station number. It was originally intended to use Ridgway's color standards for the color descriptions, but it was among the gear held by the shipping strike and no standards were available.

INDEX TO FAMILIES OF FISHES COLLECTED AT RAROIA

Table 3

FAMILY	Number of species recorded at Raroia 1/	Number of species predicted to be at Raroia 2/	PAGE
Acanthuridae	17	21	145
Aetobatidae	1	2	48
Albulidae	1	1	50
Antennariidae	2	2	169
Apogonidae	12	15	82
Aulostomidae	1	1	59
Balistidae	8	8	161
Belonidae	1	1	58
Blenniidae	26	45	131
Bothidae	1	1	160
Brotulidae	2	2	144
Canthigasteridae	4	4	166
Caracanthidae	2	2	159
Carangidae	8	16	126
Chaetodontidae	16	18	90

Table 3 (cont'd.)

FAMILY	Number of species recorded at Raroia 1/	Number of species predicted to be at Raroia 2/	PAGE
Carapidae	-	1 (?)	126
Cirrhitidae	8	9	86
Congridae	2	2	57
Coryphaenidae	-	2	-
Dasyatidae	-	2	-
Diodontidae	1	1	167
Dussumieridae	1	3	50
Echelidae	2	3	51
Echeneididae	2	4	144
Echidnidae	15	20	51
Eleotridae	6	25	140
Engraulidae	-	1	-
Exocoetidae	-	3	-
Fistulariidae	1	1	60
Galeorhinidae	3	8	47
Gempylidae	-	1	-
Gobiesocidae	1	1	143
Gobiidae	18	40	141
Hemirhamphidae	1	1	59
Histiopteridae	-	1	-
Holocentridae	15	20	61
Isuridae	1	3	47
Istiophoridae	-	2	-
Kuhliidae	1	1	82
Kyphosidae	1	2	82
Labridae	25	35	106
Lethrinidae	3	6	77
Lutianidae	7	14	79
Mobulidae	2	2	49
Monacanthidae	3	5	164
Moringuidae	2	2	58
Mugilidae	4	8	68

Table 3 (cont'd.)

FAMILY	Number of species recorded at Raroia 1/	Number of species predicted to be at Raroia 2/	PAGE
Mullidae	6	12	124
Ophichthyidae	2	5	56
Orectolobidae	1	1	48
Ostraciidae	2	3	168
Parapercidae	1	2	130
Pempheridae	1	1	86
Polynemidae	1	1	71
Pomacentridae	17	17	99
Priacanthidae	-	1	-
Pseudochromidae	2	3	76
Scaridae	14	30	117
Scorpaenidae	10	15	156
Serranidae	12	14	71
Siganidae	1	2	85
Sphyraenidae	2	2	70
Sphyrnidae	-	1	-
Syngnathidae	1	1	60
Synodontidae	1	1	51
Tetraodontidae	3	3	165
Thunnidae	1	6	130
Xiphiidae	-	1	-
Zanclidae	1	1	155

1/ Not including estimates of unsorted material.

2/ This list includes only those families confirmed to be at Raroia by collections, sight records, or identifications by natives as occurring in this immediate region. I believe that the total number given is substantially short of the fish fauna existing at Raroia, because all families that probably occur at Raroia are not included.

FAMILY ISURIDAE

Man Eating Sharks

According to the natives this family is abundant around Raroia Atoll; only a few small individuals were seen, approximately 4-6' in length, and one about 12' long. The natives fear this group and will not spear them.

Carcharodon sp. one.--Black above, white below. Teeth with single slender points.

Stations: 33(1).

Habitat: One individual approximately 5' in length taken while trolling in Garue Pass. One other slightly smaller example observed swimming in Garue Pass.

Raroian name: GAKEGAKI (small), RURUKI (large).

FAMILY GALEORHINIDAE

Gray Sharks

This group is the most abundant family of sharks occurring at Raroia, although only three species were taken. Additional species were observed but adequate collecting gear was not available. Triaenodon is speared for food, but the black-tipped sharks (Eulamia) are not eaten.

Eulamia melanopterus (Quoy and Gaimard).--General color grey to white below. All fins with solid black tips.

Stations: 11(1), 22(1), 29(1), 31(1), 47(2).

Habitat: This shark is as abundant at Raroia as all other sharks combined and occurs everywhere around the lagoon and outer reef. It is not at all abundant in the lagoon, but great numbers come over the outer reef flat to feed at high tide and they constantly patrol the outer surge channels day and night.

Raroian name: KEIKEI (small specimens), VAKI (larger specimens).

Eulamia sp. one.--Same as melanopterus in coloration except first dorsal without black. Life colors of specimen from station 45: Brown overall, pale yellowish-brown on belly. In life black edges to all fins except first dorsal distinct. Specimen 2 weeks after preservation still with same coloration as alive except black distinctly paler. Iris gold.

Stations: 33(1).

Habitat: This species is common in Garue Pass and along the outer edge of surge channels in 20-40' depths. The natives fear it and say it will attack people. It is a considerably larger species than melanopterus and adults approximately 5-6' long were observed.

Raroian name: KOKIHE.

Triaenodon obesus (Rüppell).--Overall coloration light brown. Head broad. Dorsal fins tipped white.

Stations: 45(1).

Habitat: Occasionally observed over sand flats near shore in the lagoon. The natives are not afraid of this shark and spear it for food.

Raroian name: ARAVA.

FAMILY ORECTOLOBIDAE

Carpet Sharks

Apparently there is only one species of this family at Raroia, according to the natives. They say that occasionally they are seen in the lagoon. The natives spear them for food.

Ginglymostoma sp. one.--Nasal cirrus barely reaching teeth. Upper lobe of caudal fin somewhat elongated. General color a sandy brown.

Stations: 30(1).

Habitat: Occasionally observed in lagoon on shore sand flats.

Raroian name: KOHUEHUE (small), ROHOI (large).

FAMILY AETOBATIDAE

Eagle Rays

Only one eagle ray was observed during the entire summer, although the natives say that they are normally more common. Also, the natives describe sting rays as usually being fairly abundant and we were given their native names; but none were found, despite repeated search where they were supposed

to occur. On their own initiative they pointed to drawings of sting rays in fish books and said they occur at Raroia.

Aetobatus sp. one.--This species has the teeth completely flat without mosaic arrangement. Snout somewhat elongate. Spots on underside of body as well as top. Life colors of the specimen at station 45: Solid black above with white spots. Dark markings below all black.

Stations: 45(1).

Habitat: According to the natives this species is found only on the lagoon sand flats at the southern and eastern sides of the atoll.

Raroian name: TAPERETA.

FAMILY MOBULIDAE

Manta Rays

Two species are common in the lagoon, particularly preferring the protected east side of the lagoon. Several mantas were speared from small boats but were lost.

The natives call all mantas FAFARUA but were aware that two species occurred there.

Mobula japonica (Muller and Henle).--One approximately 8-10 feet in width was watched for approximately an hour in Garue Pass, August 29th. Coloration consists of two white V's on the back; the anterior was broader and more distinct than the second. Posterior white band extended far down the side to near the tail. Inside of head flaps white. When first seen it was resting on the bottom in 25 feet of water with the flippers folded out, so that the white was evident. Later it made several circles close to the boat. Region around eyes white. Underside of body pure white. Underside of tail pure white. Eyes wide apart. Tail was fairly short, approximately one-half body length, and appeared to be normal, not broken off. Observations were made through a look-box.

Habitat: The natives say this species is often abundant in the lagoon.

Raroian name: FAFARUA.

Manta birostris (Walbaum).--Many different specimens observed along east shore of lagoon. Back solid black. Tails long and thin, approximately equal to body length. No white bands across body.

Habitat: Very abundant on eastern and southern shallow sand flats in lagoon. The mantas observed appeared to be 6-15' in width. Often two and three specimens were seen at one time.

Raroian name: FAFARUA.

FAMILY ALBULIDAE

Bone Fishes

Albula occurs in only one region at Raroia--the brackish enclosed ponds of the northeast side of the atoll. A drawing of Dixonina was shown to the natives, but they did not ever recall seeing it.

Albula vulpes (Linnaeus).--Iridescent silver to blue above. Examples over 12" are rare, most being about 6-8" long.

Stations: 37(1), 38(8), 40(1).

Habitat: Storms keep enclosed pools on the northeastern islets filled with brackish water, forming an ecological condition unique to this part of the atoll. The dominant species are mullet and particularly Albula. The floor of these pools are thickly covered with silt and detritus, and the water is usually murky. No Albula were seen in any other habitat.

Raroian names: PATI AND KIOKIO for adults, NIFA for young.

FAMILY DUSSUMIERIDAE

Herring

The number of clupeoid species occurring around Raroia is apparently slight and only one genus and species was collected.

Spratelloides sp. one.--Life colors of specimens from station 41: general color on body silver to bluish-silver. Stripe along side narrow anteriorly, broad posteriorly, silvery-blue. Eye also bluish-silver shading to black on eyeball.

Stations: 41(100).

Habitat: Very abundant over certain lagoon coral heads in large close-packed schools. Hemirhamphus were observed chasing them. The

natives say that during certain seasons, great shcools of them form masses along the western shore of the lagoon. At these times the natives scoop them out with nets and buckets and have community feasts.

Raroian name: PIHERERE.

FAMILY SYNODONTIDAE

Lizard Fishes

One species of Synodus of various color patterns was found to be abundant in the sand around the base of lagoon reefs and coral heads. No other synodontids were found. The natives do not use this family for food.

Synodus variegatus (Lacépede).--Palatine teeth in two rows. Inner pelvic rays longer than outer. Adipose fin with a large brown spot. Body and fins crossed by brown bands. Life colors of specimen from station 57: Ground color brown to reddish-brown above fading to silvery-white below; body crossed by approximately ten vertical irregular brown bands. Head mottled brown, lighter below. Lower jaw crossed by six suffuse lines. Interorbital and tip of upper jaw pale black. Breast and belly pure white. Dorsal fin membranes hyalin; rays with five or six horizontal series of irregular brown lines. Caudal fin crossed by six or seven vertical brown bands that are often divided; otherwise fin pale. Anal fin with four oblique brown bands along length of fin; membranes otherwise hyalin. Pelvic fins with approximately 6 faint brown bands. Pectoral fins with vertical brown bands that fade out on lower rays.

Stations: 7(1), 12(1), 22(1), 23(11), 28(8), 38(1), 42(1), 57(1), 61(11), 65(1).

Habitat: Abundant in lagoon on sand bottom around coral heads and shore reefs. These fishes hide in the sand or in holes during the day and come out to feed at night.

Raroian name: KARAEA.

FAMILY ECHIDNIDAE

Moray Eels

At least 15 species of this family were recorded in field notes, but the data was prepared from only approximately half of the total collections. Various species seemed to have different color phases and many were extremely difficult or impossible to identify. As a result the following notes are inadequate.

The family Echidnidae is abundant wherever there is active coral growth or hiding places under rocks. None were found in the sand, but the family dominates the fish fauna of the outer reef coralline ridge and shallow tide pool region on the reef flat next to the beachrock shore. They are also very abundant in the inter-islet channels that are continuous at high tide between lagoon and outer reef. Most species are distinctly restricted to definite habitats and the greatest number of species and individuals occur on the outer reefs.

The natives are quite confused over names for most of the species and although they know a great number of names for eels, they are often uncertain about using them correctly. The Raroian names given with the following species are the ones Bengt Danielsson and I repeatedly checked with different natives. The natives eat only the large moray eels over three feet long, roasting them whole, wrapped in palm leaves. The largest moray seen at Raroia (Gymnothorax javanicus) was slightly over four feet long.

Echidna leucotaenia Schultz.--Color plain brown with white dorsal and anal fins. Head white, striped with brown. Some teeth molariform.

Stations: 17(8).

Habitat: Rare at Raroia; in the outer reef surge channels and in the sea urchin holes on the coralline ridge.

Raroian name: MAKIKI.

Echidna sp. one.--Distinctive characteristics consist of molariform teeth, 30 broad vertical brown bands with pale brown interspaces; irregular outline of bands. Tail approximately as long as body. Similar to E. polyzona but markings different.

Stations: 28(1).

Habitat: Only one specimen recorded from a lagoon coral head.

Raroian name: none.

Enchelynassa canina (Quoy and Gaimard).--Distinctive colors solid brown without markings. Anterior nostril with an expanded lobe. Posterior nostril with a raised flaring rim. Life colors of specimens from station 58. Head and body solid brown; head distinctly lighter, particularly behind eye onto occiput. Pores above and below bordering jaws cnetered in white circles. Snout and lower jaw tip dark brown. Fins with dark brown base shading to white on outer half. A large specimen, approximately 2' long, (very likely another species) is dark brown to blackish-brown overall, without any marking or light areas. Nostrils somewhat different than on smaller specimens.

Stations: 17(6), 26(1), 45(1), 58(4), 59(1).

Habitat: Outer reef surge channels down to 15' at least and over entire coralline ridge living in the sea urchin holes. One of the dominant moray eels in the surge channel region.

Raroian name: MAKIKI.

Uropterygius xanthopterus Bleeker.--Head and body dark brown to black specked with white and bluish white dots. Midcaudal rays long.

Stations: 10(8), 17(7), 45(1).

Habitat: Moderately common in outer reef surge channels and next to shore on reef flat. Burrows deep into cracks in the coral and is very difficult to collect.

Raroian name: none.

Uropterygius fasciolatus (Regan).--Vertical fins confined to tail. Posterior nostrils in a raised tube. Head and body with about 42 dendritic stripes. Ground color brownish white. Dark stripes narrower than light interspaces.

Stations: 17(1), 26(1).

Habitat: Rare at Raroia. Taken in outer reef surge channels.

Raroian name: none.

Uropterygius marmoratus (Lacépède).--Tail longer than snout. Color pattern mottled. Gill operning on level with eye. A single pair of nostrils present. Life colors of specimen from station 11: ground color pale brown. Body mottled with black and brown spots superimposed on each other. Iris golden brown.

Stations: 11(1).

Habitat: Recorded specimen taken from under rocks in an interislet channel near Garue Pass.

Raroian name: none.

Gymnothorax fimbriata (Bennett).--Distinctive characters consist of a green edge to fins, gill opening not in black spot, body and fins covered with round black spots, and ground color solid brown. Life colors of specimens from station 49: Ground color overall a solid brown tinged with green, somewhat lighter below. Head with tips of jaws slightly darker. Small black spots on upper part of head behind eye. Black spot at rictus of upper jaw. Gill opening not in black spot. Vertical fins same color as body, edged in white in smaller specimens, and edged in green in larger. Dorsal fins with oblique spots along the entire

length of fin; posteriorly they are continuous with those on body. Anal fin without entire spots, only lower edges of spots on body extending onto fin. Body with approximately 3 series of black spots along its length; anteriorly the spots are smaller than the interspaces, posteriorly they are approximately the same size or somewhat smaller. Caudal fin with continuous color pattern of dorsal and anal, also light edged. Pores bordering upper and lower jaws in white spots.

Stations: 49(5).

Habitat: Lives in the Ulva-like Microdictyon on lagoon coral heads.

Raroian name: KIARI.

Gymnothorax monostigma (Regan).--A large black blotch bordering eye posteriorly. Head and body dark brown without any other markings. Pores on lower jaw surrounded by white. Posterior nostrils in long white tubes. Iris red.

Stations: 17(1), 45(12).

Habitat: Outer reef surge channels and sea urchin holes in the coralline ridge. This species was observed only at a few stations.

Raroian name: none.

Gymnothorax gracilicauda Jenkins.--Body brown, with 45-50 vertical dendritic darker brown vertical stripes. Lower jaw white with brown tip. Upper jaw with one maxillary row of teeth and one or two inner teeth. No black spot on gill opening. Head long, occiput not gibbous. Anal fin white. Dorsal fin same color as head and body except edged in white.

Stations: 17(2), 26(6), 45(3).

Habitat: Moderately common in outer reef surge channels.

Raroian name: none.

Gymnothorax picta (Ahl).--Intermaxillary teeth reduced. Color pattern consists of black specks or tiny black spots on a white background. No teeth molor-like. In specimens below 100 mm. the spots on the body occur in 4-6 irregular rows along body. In specimens 150-200 mm. the spots have pale centers. In specimens 200-300 mm. blackish rings are broken into small spots and arranged in a ring of spots. In the very large specimens the body becomes speckled with tiny black spots.

Stations: 8(10), 10(1), 11(11), 14(5), 22(6).

Habitat: This species is very abundant in the shallow inter-islet channels and next to shore on the outer reef flat. It lives in holes

in the beachrock and dead coral blocks. This species comes out at high tide to feed.

Raroian name: KUIRU.

Gymnothorax flavimarginata.--Vertical fins edged in green. Gill opening black. Body black, mottled with brown and black.

Stations: 8(11), 10(5), 11(3), 13(1), 14(1), 22(3), 23(1), 26(9).

Habitat: One of the most abundant eels at Raroia, occurring in a wide variety of habitats in the outer surge channels, reef flats and on lagoon coral heads and shore reefs.

Raroian name: MAKIKI.

Gymnothorax javanicus (Bleeker).--Black spots along body in 3 irregular series. Ground color solid brown. Gill opening in a black spot. No inner teeth on maxillary.

Stations: 9(1), 12(1), 23(10), 28(1), 42(1), 44(1), 58(1), 61(5), 66(4).

Habitat: Moderately abundant on lagoon coral heads and shore reefs; uncommon on outer reef although occasionally observed in large pot holes on coralline ridge. This is the largest moray eel at Raroia and is commonly eaten by the natives. The natives fear this eel more than all others and kill them whenever possible, whether they want to eat them or not.

Raroian name: HAMURENGA (small), TIOHU (medium), TAVERE (large).

Gymnothorax buroensis (Bleeker).--Three rows of maxillary teeth present. General coloration with large black blotches on light brown body. Small specks and dendritic spots of darker coloration over head and body. Anterior nostrils white. Gill opening not in black spot.

Stations: 17(1).

Habitat: A few specimens observed in outer reef surge channels.

Raroian name: KIARI.

Gymnothorax thyrsoidea (Richardson).--Ground color solid brown. Darker brown dendritic spots over body, tending to form vertical rows posteriorly. Tiny darker specks and spots overall. Maxillary with two rows of teeth, the inner series consisting of approximately 8-10 teeth.

Stations: 17(8), 28(7).

Habitat: Taken in outer reef surge channels and on lagoon coral heads.

Raroian name: KIARI.

Gymnothorax petelli (Bleeker).--Characterized by black vertical stripes on a white body.

Stations: 17(6), 22(2), 26(1), 45(2).

Habitat: This is one of the dominant moray eels on the outer reef coralline ridge in sea urchin holes and in the surge channels.

Raroian name: TAKATAKA.

FAMILY ECHELIDAE

Worm Eels

According to field notes, several species of echelid eels were collected but only one was recorded. They were quite hard to collect, only a few being obtained after several hours exposure to rotenone. The natives know nothing about them and referred to them by the general eel term KOIRO. They do not eat them.

Muraenichthys laticaudata (Ogilby).--Characterized by the dorsal fin origin over anus, the eye situated over rictus, the posterior nostril in the upper lip, and a light brown coloration without distinctive markings. Life colors of specimens from station 58: yellowish-light brown overall. Iris light blue. Fins same color as body, pale.

Stations: 17(2), 20(1), 58(2).

Habitat: Taken only in deep surge channels next to the coralline ridge of the outer reef flat. All specimens were collected in 12-20' of water.

FAMILY OPHICHTHYIDAE

Snake Eels

At least two species were collected of this family, but only one was recorded in field notes. Since this group burrows in sand and never was killed at Raroia by the rotenone, it is very likely that all species were not collected.

The family was found only in the lagoon in shallow water on tops of coral heads and shore reefs. Some natives gave the name MATIROHE to this group but they might have made up this name for the occasion. Sometimes the natives would be embarrassed at not having a name for some common fish and invent a name for it.

Leiuranus semicinctus (Lay and Bennett).--Dorsal fin origin over gill opening. Twenty-eight spots along head and body, separated by broad white interspaces.

Stations: 9(1), 12(1), 28(1), 61(1).

Habitat: Moderately common burrowed deep in the sand in lagoon, in shallow water on top of shore reefs and coral heads. Most abundant on west side of lagoon.

Raroian name: MATIROHE ?

FAMILY CONGRIDAE

Conger Eels

The conger eels are of minor importance at Raroia and only two species seem to occur there. This family is almost entirely limited to a shallow sandy environment on top of coral heads or shore reefs in the lagoon. Seldom were more than one specimen seen at the same locality. These eels burrow in the sand similar to Moringua, and were taken entirely by poison. The natives know very little about them and do not eat them; they give them the general eel name KOIRO, but only the older natives use this name with any certainty.

Conger cinereus Rüppell.--Characterized by very small pectoral fins, uniform coloration on head and body, and a submarginal black edge to the vertical fins.

Stations: 7(3), 8(1), 9(1), 23(1), 28(2), 45(1).

Habitat: This species lives in the sand in shallow water less than 4' in depth on the shore reefs and tops of coral heads in the lagoon. It would usually take an hour or more before the rotenone would drive them out of hiding. Actually this eel may be more abundant than the collections indicated. The rotenone might not have affected adults, since only young specimens were taken. Also adults may only be in deeper water than our collecting permitted.

Conger sp. one.--Characterized by a blunt short body and an all white coloration.

Stations: 9(1).

Habitat: One specimen taken on west coral shelf in lagoon.

FAMILY MORINGUIDAE

Worm Eels

This family was almost completely unknown to the natives until our ichthyocide drove them out of the sand. Some individuals are buried over a foot deep in sand at the base of coral and often it would be several hours before rotenone would affect them. This group is confined to water less than six feet deep, and very seldom was noted outside the lagoon. Some natives said these eels are called HOEA but others said there is no name for them.

Moringua abbreviata (Bleeker).--General color orangish-red. Eye minute. Pectoral fins lacking. Lower jaw longer than upper. Vertical fins confined to extreme tip of tail.

Stations: 8(3), 9(3), 10(4), 28(7), 61(2).

Habitat: In shallow water burrowed in sand. Common on lagoon west shore reefs and sand-topped coral heads near shore. Most examples observed near bases of coral growth. Largest concentrations on lagoon west shore reefs in region of Garumaoa Village to Garue Pass.

Raroian name: none.

Moringua bicolor Koup.--Characterized by lower jaw longer than upper, fairly large eye, well developed pectoral fins, a general silver coloration, and by vertical fins interrupted on tail.

Stations: 8(3), 11(1), 28(1).

Habitat: Same as Moringua abbreviata except not as common.

Raroian name: none.

FAMILY BELONIDAE

Needle Gars

One species present at Raroia scattered in open surface waters in moderate numbers. The natives are not familiar with any other species occurring at Raroia.

Belone platyura Bennett.--Life colors prepared at station 38 iridescent silver with blue above. White below.

Stations: 27(12), 35(1), 38(1).

Habitat: Adults come onto the outer reef flat around the atoll during high tide at night to feed. Small schools are moderately common in the open surface water of the lagoon. The natives use this species for bait, but do not eat them.

Raroian name: KAGU.

FAMILY HEMIRHAMPHIDAE

Half Beaks

Only one species known at Raroia that is very abundant in the lagoon and along the outer reef.

Hemirhamphus pacificus Steindachner.--Teeth minute in jaws. Preorbital as long as eye. Pelvics slightly nearer caudal fin than head. 46 predorsal scales present. No stripes present on body. Tip of lower jaw reddish-orange in life. Life colors of specimens from station 58: General color iridescent silver, blackish above. A median silver stripe present down side that turns blue or black in formalin. Belly silvery white. Head iridescent silver on sides, blackish or bluish black on top of snout and head. Iris iridescent silver. Dorsal fin edge hyalin. Caudal fin dusky black on upper lobe; lower lobe hyalin with scattered chromatophores. Anal fin hyalin except for scattered melanophores near tips of first rays. Lower jaw with fleshy tip red. Pelvic fins hyalin except for dusky bases to the first rays.

Stations: 7(6), 9(11), 12(1), 17(1), 22(1), 26(4), 27(36), 28(2), 38(2), 39(5), 45(6), 58(4), 61(1).

Habitat: This species is one of the most common fishes at Raroia and occurs in large schools in the open water. At night at high tide, great numbers come onto the outer reef flat to feed. The natives catch them with nets for food and bait. They troll for larger open water fish with them.

Raroian name: FANEA.

FAMILY AULOSTOMIDAE

Trumpet Fishes

Aulostomus is very prominent around coral in the lagoon and inter-islet channels. It was not observed in swifter moving water, in the Passes or around the outside of the atoll. This form is one of the main scavengers of the coral reefs, and is easily taken with baited traps. The natives unintentionally take them on hook and line and seldom eat them.

Aulostomus chinensis (Linnaeus).--This species is remarkably variable in color. Some specimens are yellow to yellow-orange overall. Other individuals vary from a solid brown to a dark grayish-brown. A few examples were mottled with white and black and dark browns to black.

Stations: 7(1), 9(3), 23(1), 28(1), 32(2), 42(1), 46(1), 57(1), 66(2).

Habitat: Most abundant on the lagoon west shore reefs and neighboring coral heads. This species was attracted to rotenone stations where they would gorge themselves on the smaller dead fishes while they in turn succumbed to the effects of the derris root. While spear fishing around coral heads we would often see lines of Aulostomus head to tail winding in and out of the coral. Also, large adults would often be seen right next to large sea basses closely following them along as they moved about. Apparently, this peculiar association was for protection and for feeding on the sea basses prey.

Raroian name: KAKAVERE TUPOUPOU.

FAMILY FISTULARIIDAE

Cornet Fishes

The relative abundance and distribution of the single species observed at Raroia is the same as for Aulostomus.

Fistularia petimba Lacépède.--General color brown to greyish-brown.

Stations: 7(1), 8(1), 9(2), 10(1), 22(1), 28(2), 33(1), 35(1), 45(2).

Habitat: This species appeared to have almost identical habits as Aulostomus, although they were more often observed in the inter-islet channels than the other genus. Also this species comes onto the outer reef flat at night to feed and the natives kill them with long knives and use them for bait, particularly for night fishing. The natives do not eat them.

Raroian name: KAKAVERE.

FAMILY SYNGNATHIDAE

Pipe Fishes

Despite intensive search in habitats where pipefishes normally occur, only one rather common species of Corythoichthys was collected. This pipefish

congregates around particular tide pool coral patches and individuals are not found between these areas. They feed in the tide pools at low tide, keeping within the immediate vicinity of their coral patch. At high tide they hide in the coral, just the opposite of most outer reef flat fishes.

Corythoichthys sp. one.--Snout slender, sharply pointed. Tail and snout bright red. Dorsal fin covered with red spots. Approximately 16 spots down side of body. Two dark longitudinal lines on side of head. Dorsal fin with 32 rays.

Stations: 10(10), 11(1), 22(1), 25(10), 57(1).

Habitat: Entirely confined to restricted coral patches in tide pools next to shore on outer reef flat and occasionally in mouths of inter-islet channels on outer reef flat. Noted only on west side of atoll.

Raroian name: none.

FAMILY HOLOCENTRIDAE

Squirrel Fishes

Without a doubt the most confusing group of fishes at Raroia is the Holocentridae. There seem to be species in both Holocentrus and Myripristis that are very similar in appearance even in fresh material and it was difficult to do an adequate job with field determinations. A large number of kodachrome slides were taken, copious color notes and field sketches prepared, and it is hoped that this data will prove of value. Practically all of the specimens taken are incorporated in the following notes. Fifteen species are recognized in the field records, but it is suspected that further study will expand the number. It is believed that all species normally occurring at Raroia were taken.

The family is abundant in shallow water to 15-25' wherever there is coral or hiding places. Few specimens are observed during the day, but remain hidden in holes. At night they come over the reef flats in great numbers to feed. They are specially abundant at night in the outer reef surge channels and on the outer reef flat.

The natives are hopelessly confused over the names of most species, and there was definite agreement for only KIOA, TIKEIKEI, RUKERUKE, PETI and PETIMU. The remaining names have been given by the more reliable of the older natives. Apparently at one time each species was named, but now the natives are not sure to which species most of those names belong. The natives eat RUKERUKE, PETI and PETIMU, but usually not the other species.

Holocentrus sammara (Forskål).--Dorsal fin with a distinct large black blotch between first four spines. Upper and lower edges of caudal fin black. Anterior edge of soft dorsal and anal black. Life colors of specimens from station 61: General coloration red above to silver below. Head black to reddish-black on interorbital. Top of snout dusky red. Iris silver, tinged with red around lens. Cheeks silver with brownish black spots. Lips white. Underside of head white. Operculum brassy reddish-brown. Eyeball black above with narrow horizontal red line. Body with dusky brown lines along scale rows. Body above dusky red. Lateral-line forming a conspicuous dusky red line that is the most prominent of the markings along the side. Scales above anal fin with dusky brown centers. Breast and belly silver white. Spinous dorsal fin with large black spot on first three membranes; spot edged in red. Outer tips of all membranes pure white. Near base of each membrane of spinous dorsal is a large white spot, except last which is all red without white edge. Middle of fin pale dusky black fading into red on last membranes. Soft dorsal anteriorly edged reddish-black, fading to yellow and then hyalin posteriorly. Caudal fin reddish-black on upper and lower most rays, middle of fin pale yellow; posterior edge hyalin. Anal fin with third spine and first soft ray pale red. Remainder of soft fin hyalin. Membranes between second and third spine white, hyalin at outer edge. Pelvic and pectoral fins hyalin. Upper pectoral rays tinged with red. Fine pale brown spots immediately before pectoral fin but not below.

Stations: 7(1), 14(2), 22(10), 23(1), 27(1), 42(1), 47(1), 60(1), 61(6), 65(2).

Habitat: Moderately abundant in shallow water around coral heads and shore reefs, occurring in greatest numbers on the outer reef flat at night. Found in association with Holocentrus laevis.

Raroian name: TINGITINGIA.

Holocentrus laevis Günther.--Dorsal fin plain. Upper and lower edges of caudal fin black. Black spots on preopercle. Life colors of specimens from station 61: Coloration very similar to sammara except paler red, and spots on cheek and around pectoral base more distinct. Head reddish-black to reddish-brown above, darkest on interorbital. Iris silver, a vertical reddish-black band immediately behind iris; it is sometimes anteriorly tinged with red. Cheeks with a distinct brownish-black spot on almost every scale; otherwise silvery white. Jaws white, except for dusky tips. Opercular edge light reddish-brown, a row of brown spots bordering preopercle edge. Body reddish-brown above to silvery-white below. Each scale row with a longitudinal dusky brown line; these are faint below lateral-line. Lateral-line reddish-brown, forming the most prominent marking on the body. Breast before and below pectoral fin with 3-4 longitudinal rows of brownish-black spots; lowest with seven spots. Spinous dorsal hyalin; there may be a faint red spot on first membrane near tip. Soft dorsal with first rays red; remainder of fin tip pale yellow to hyalin. Caudal fin with outer

rays reddish-black to solid red posteriorly. Middle rays pale yellow. Posterior edge of middle rays hyalin. Anal fin hyalin except third spine and first soft ray pale red. Membranes between second and third spines white. Pelvic and pectoral fins hyalin. Upper pectoral rays tinged with red.

Stations: 8(2), 9(2), 13(1), 23(3), 28(2), 61(10).

Habitat: Confined to the lagoon reefs and coral heads in shallow water. Found in association with Holocentrus sammara but not as abundant.

Raroian name: TINGITINGIA.

Holocentrus opercularis Valenciennes.--Spinous dorsal with a wide black band; tips of membranes white; dorsal third of membranes white with a black spot anteriorly between each spine. Second dorsal fin with first ray red, remainder orange. Caudal fin with outer rays reddish-black. Inner rays orange. Anal fin with third spine and first soft ray red. Remainder of fin orange. Pelvic fins pale, slightly reddish. Pectoral fins pale red. Head red to reddish-black; operculum darkest. Body red to brownish-black dorsally. Each scale row tends to have dark longitudinal lines ventrally. Bottom of head and body white. Above color notes prepared from preserved specimens from station 31.

Stations: 33(1), 61(2), 65(2).

Habitat: Rare at Raroia; taken on lagoon coral heads and shore reef in Garue Pass. A few additional observations record them from widely scattered coral heads in lagoon.

Raroian name: KIOA.

Holocentrus microstomus Günther.--Characterized by a black blotch between first to third dorsal spine, then a weak greyish blotch between each spine on membranes. Posterior spinous rays with black spots basally; tips of all membranes red; basal portion white. Seven broad longitudinal stripes on body.

Stations: 7(1), 9(3), 28(3), 38(1), 49(9).

Habitat: A nondescript species that is moderately abundant in shallow water around lagoon coral heads and shore reefs. Specimens were also taken in enclosed brackish pools on northeast islets.

Raroian name: TIKEI.

Holocentrus caudimaculatus Rüppell.--Forty-two scales between opercular edge and caudal fin base. Head and body brownish-red with faint brown mottled specks. No distinct longitudinal stripes. Spinous dorsal

with basal third of membranes pale red; middle third pale black; outer third brilliant solid red. Soft dorsal, anal and caudal fins orangish-red. Pelvic fins hyalin. Life colors of specimen from station 58: Head and body brownish-red above, shading into silvery white below. Head reddish-brown above, specked with brown over side, including cheeks and lips. Underside of head mostly white, with scattered brown pigment cells. Operculum with a brown spot above, silver-brown over most of operculum. Body specked with brown over sides to level with pectoral fins. No distinct stripes on body though the brown specks tend to clump on the scale rows, forming vague longitudinal bands. Anus black. Spinous dorsal fin edged in a solid bright red band. Middle of fins suffuse black, solid black dorsally; basal portion solid red, varying in distribution and intensity among specimens. Soft dorsal reddish on first rays, dusky black for remainder of fin (tinged with red) with hyalin edge. Caudal fin pale red, the upper and lower most rays hyalin, the edge of the fin hyalin; upper and lower rays brightest red. Anal fin soft rays pale red basally, hyalin at tips; first 2 soft rays bright red. First two spines white; third spine red; spinous membranes and soft ray membranes hyalin. Pelvic and pectoral fins hyalin. Upper pectoral rays tinged with red.

Stations: 8(1), 9(1), 11(1), 14(1), 20(1), 23(1), 26(2), 27(61), 45(16), 58(1), 59(5), 65(1), 66(5), 10(1).

Habitat: The most abundant holocentrid at Raroia in shallow water on shore reefs and coral heads. Great numbers come over the outer reef flats at night at high tide to feed.

Raroian name: TEMU.

Holocentrus diadema Lacépède.--Characterized by horizontal black stripes, and a solid black spinous dorsal fin with oblique white stripe. Life colors of specimens from station 61: General colors solid bright red with white lines. Head solid red except for white line between eye and upper jaw which continues to opercular margin, and a vertical white line on preopercle that includes large spine. Top of head red, slightly darker on interorbital. Lips red. Underside of head pale red except for gill membranes which are pure white. Iris red, irregularly edged in silver. Body with nine longitudinal white lines, that extend the length of the body; two short white lines on breast as well as a median line down breast and belly; also a median dorsal line before dorsal fin. White lines become broader ventrally; on midlateral region they are edged by brown lines. Body is brownish-red dorsally. Spinous dorsal fin black with tips of all membranes except last hyalin. Remainder of fin solid black except for an oblique longitudinal white line that is disrupted on middle rays. Soft dorsal red across middle of rays, remainder of fins including membranes hyalin. Outer caudal rays red, middle rays pale red. Outer edge of middle rays hyalin. Anal fin pale black between third and fourth spine. Fourth spine and first soft ray red. Remainder of rays pale red and membrane hyalin.

Pelvic fins with first two soft rays bright red. Remainder of rays pale red and membranes hyalin. Pectoral fins hyalin, upper rays pale red.

Stations: 7(1), 9(1), 12(2), 13(2), 23(6), 28(11), 49(1), 61(8), 65(1).

Habitat: Common at Raroia, but almost entirely confined to lagoon coral heads.

Raroian name: TIKEIKEI.

Holocentrus binotatus Quoy and Gaimard.--Characterized by a solid red dorsal fin with two small black spots at the base of the first two membranes. No silver area on caudal peduncle. Life colors of specimen from station 49: Head and body solid red without dark markings. Interorbital dusky black. Iris red posteriorly, golden anteriorly. Body solid red above, shading into light red indistinct stripes below. Caudal peduncle solid red. First dorsal brilliant solid red with a suffuse black spot at the base of each of the first two membranes. Second dorsal with anterior rays all red; remainder of rays red basally. Caudal fin rays red at base and on tip of upper lobe; edge of lower lobe hyalin. Anal fin soft rays red basally and on all of first ray membrane; remainder of soft fin hyalin. Anal spine red. Pelvic fins with soft rays dusky red across middle of fin, membranes hyalin. Pectoral fins pale red, lower rays hyalin.

Stations: 49(1).

Habitat: One specimen taken on a lagoon coral head.

Raroian name: TIKEKE.

Holocentrus spinifer (Forskål).--Life colors of adult from station 55: Head and body uniform brilliant red. Head with a bright red vertical patch immediately behind eye. Iris golden red. Lens black. Body uniformly red. Spinous dorsal fin brilliant solid red that breaks down to yellow when preserved in formalin and finally becomes pale white. Soft dorsal pale red on rays; membranes hyalin except for pale red on middle of anterior rays. Caudal fin red shading to hyalin at posterior edge. Membrane between second and third anal spine orange-red; anterior soft rays red shading into yellow on last rays; membranes pale orange-red. Pelvic fins uniform reddish-orange. Pectoral fins orange shading to hyalin on outer one-third.

Stations: 20(1), 23(8), 28(7), 45(12), 55(1), 60(3), 61(7).

Habitat: Solitary individuals live in holes around lagoon coral heads and shore reefs. This species is abundant at night in the outer reef surge channels but does not come onto the outer reef flat. It bites on a hook at night. Uncommon in surge channels during the day.

Raroian name: TIKEI (young), RUKERUKE (large).

Holocentrus sp. one.--Characterized by a brilliant solid red coloration overall. Tiny black specks on head and horizontally on scale rows. Spinous dorsal with large black spots on first two membranes. Suffuse pale spot at posterior edge of each membrane for other spinous rays. Remainder of spinous membranes reddish-black. Other fins solid red.

Stations: 17(2).

Habitat: A few small specimens observed and taken in outer reef surge channels.

Raroian name: TEMU.

Holocentrus sp. two.--First dorsal without black pigment. Large red patches dorsally between first two spinous membranes; reddish-orange streaks near tips of other membranes, particularly last three; otherwise spinous dorsal hyalin. Body without distinct dark streaks, but a great number of black specks cover head and body. Fins other than first dorsal pale reddish-orange. Outer rays of caudal fin slightly darker at base. Head reddish-black on interorbital and occiput; black spot on upper region of operculum.

Stations: 22(55), 57(6).

Habitat: Taken only north of Garue Pass in inter-islet channels and lagoon shore reefs.

Raroian name: TEMU.

Holocentrus sp. three.--Head without distinct markings. Spinous dorsal with red band in upper membranes with a narrow white tip. Last membranes with red spots at base; middle of fin pure white. Life colors of specimens from station 57: Head reddish above, silver and white below. Opercle with a vertical dusky red band anteriorly. Lips pale red. Branchiostegal membranes and underside of head pure white. Body with 8 distinct longitudinal red bands extending to caudal fin base; some of the dorsal bands are very short. Soft dorsal red anteriorly, shading to pale red on last rays and hyalin at edge. Caudal fin with outer rays red and inner rays pale red. Anal fin bright red between second and third spines, pale red on soft rays shading to hyalin distally. Pelvic fin with first ray red, shading to hyalin on last ray; membranes hyalin. Pectoral fins pale red.

Stations: 13(1), 23(9), 27(1), 42(1), 57(2), 65(3).

Habitat: Taken on lagoon reefs and coral heads on west side near shore and on outer reef flat.

Raroian name: none.

Holocentrus sp. four.--Similar to RUKERUKE but has white edge to spinous dorsal and lacks preopercular red patch. Life colors of specimens from station 66: Overall brilliant red. Head solid red above (not at all black). Iris silver around lens, remainder red. Body solid red above shading into suffuse longitudinal red stripes below. Belly and breast white, with scales basally white posteriorly edged in red. Spinous dorsal brilliant solid red, the outer edge pure white. Soft dorsal and soft anal anteriorly solid red to posteriorly only red on rays; membranes posteriorly hyalin. Caudal fin solid red. Anal fin solid red between third and fourth spine except pure white distally next to third spine. Pelvic fins red, brightest anteriorly, with a pure white anterior margin. Pectoral rays red, membranes hyalin.

Stations: 26(1), 66(4).

Habitat: Outer reef surge channels and shore reefs of Garue Pass.

Raroian name: TIKEI.

Myripristis murdjan (Forskål).--Characterized by the second dorsal and anal fin having an anterior white edge followed by a dusky black vertical line. Life colors of specimens from station 49: Overall red, darker above. Head red, reddish-black above. Eye black above. Iris with a large rectangular silvery spot behind eye ball. Iris golden red shading into purple anteriorly and golden below. Posterior edge of eye brown. Opercular flap brown as are scales bordering it on body. Body silver, each scale edged in red for ventral scales, edged in brownish-red for median scales, and above lateral line each scale purplish-silver with a dark brown edge. Spinous dorsal edged in white; a broad red band longitudinally down the middle of each membrane which may have patches of yellow in it; basal part of membrane pale yellow. Soft dorsal with first ray white; remaining rays red. Dusky black region behind white almost lacking in specimens here described. Distal region of second to fifth soft rays bright red. Caudal fin bright red. Anal fin same as dorsal. Pelvic fins with first soft ray white, next rays red, shading to hyalin for last ray. Tips of all soft rays hyalin except second. Pectoral fin pale red, hyalin distally.

Stations: 7(2), 9(2), 12(1), 13(2), 27(4), 28(5), 42(4), 45(18), 49(4).

Habitat: Abundant on lagoon coral heads, shore reefs and outer reef flat. Also observed in outer reef surge channels at night.

Raroian name: PAPURAGO (small), PETI (large).

Myripristis adustus Bleeker.--Characterized by broad black tips to soft vertical fins. Fourteen soft dorsal rays. Life colors of specimens from station 28 one month after preservation: General color black above to dull reddish brown below. Head black on top of head. Lips blackish.

Black spot on opercular margin. Iris black. Spinous dorsal edged in solid black; base black shading to white on middle of fin. Soft dorsal and soft anal broadly tipped black; remainder of these fins dusky yellow. Caudal fin edged in black, anteriorly shading to yellow for most of fin. Pelvic and pectoral fins pale yellow.

Stations: 28(2).

Habitat: Apparently restricted to a few large lagoon coral heads. This species is prized for food by the natives but they seldom find them. At station 28 approximately 15 were collected but were dispatched by the natives before they could be preserved.

Raroian name: PETIMU.

Myripristis sp. one.--Characterized by no black markings on dorsal or anal fins. Opercular margin black. Pectoral fin axis black. High number of gillrakers on first arch. Life colors of specimens from station 61: Head and body solid red. Iris golden red anteriorly and posteriorly, black above, and golden to reddish-golden below. Spinous dorsal solid red, pale red or whitish-red centrally on each membrane. Soft dorsal and anal bright solid red; posterior rays shading to pale red at tip. Caudal fin bright solid red, median rays fading to pale red at tip. Pelvic fin rays pale red anteriorly, shading to lighter red posteriorly. Membranes between spine and first soft ray pale red. Pectoral fins pale red on rays and membranes, fading to hyalin at tip.

Stations: 23(25), 28(1), 61(10).

Habitat: Abundant around lagoon shore reefs and coral heads.

Raroian name: PETI.

FAMILY MUGILIDAE

Mullet

Four species of mullet are recorded from Raroia and probably additional species were taken. All species noted were not collected so that there appear to be at least eight species occurring at this atoll. The family is most abundant schooling along shore in the lagoon and on the outer reef flat at night feeding at high tide. It is also the dominant family besides Albulidae in the brackish enclosed pools on the northeast islets; the young are especially abundant in these pools.

The natives use this family for food, but prefer many groups of fishes before eating mullet. All the species have specific Tuamotuan names.

Myxus leuciscus Günther.--Each jaw with one row of fine teeth pointing downward. Jaws strongly oblique. Approximately 35 scale rows between opercular margin and caudal fin base. No spot at pectoral fin base. Lips without crenulate flaps. Edge of caudal fin black.

Stations: 16(2), 22(1), 27(2), 37(1), 38(8), 58(1).

Habitat: This species has a surprisingly varied distribution. It is dominant mullet in the northeast brackish ponds and on the outer reef flats. The natives use them for food.

Raroian name: UOA.

Mugil crenilabis Forskål.--Upper lip with several rows of fleshy papillae. Lower lip crenulated. Black spot present on pectoral fin base. Life colors of adult from station 60: Head and body iridescent silver overall, dusky black above. Head darkest on snout. Lips and lower half of head white. Iris golden. Spinous dorsal dusky black on spines, membranes hyalin. Soft dorsal and anal scaled over most of fins, rays dusky black. Caudal fin dusky black. Pectoral fin with a black spot at upper edge of base, otherwise brownish black.

Stations: 60(1).

Habitat: A small school observed along shore of Teremu Islet, over sand bottom.

Raroian name: KANAE.

Mugil engeli Bleeker.--Posterior adepose eyelid present. Mouth almost level, without projecting teeth. Lip edges smooth. Life colors of specimens from station 60: Head and body iridescent silver, darker above. Head grayish on top; upper lip dusky black. Iris silver, ringed with yellow-orange. Body blackish above shading to pure silvery white below. Dorsal fin with dusky black rays, scattered melanophores on membranes near rays. Caudal fin dusky black, with an abruptly blacker posterior edge. Anal fin same as dorsal. Pelvic fins hyalin. Pectoral fins dusky black on basal two-third of rays, membranes hyalin.

Stations: 60(4).

Habitat: Abundant in small schools on west side in lagoon next to shore. They swim at surface feeding, bobbing the tops of their heads out of water. Often in association with Mugil vaigiensis.

Raroian name: KAVATA.

Mugil vaigiensis Quoy and Gaimard.--Characterized by black pectoral fins, by a pale caudal fin, and by the pectoral fin being shorter than the head.

Stations: 22(1), 38(3), 60(12).

Habitat: Common in lagoon along shore and around coral heads near shore. Small schools present in brackish ponds of northeast islets and scattered individuals on outer reef flats, particularly at high tide.

Raroian name: TUGOUGOU (small), HOPIRO (large).

FAMILY SPHYRAENIDAE

Barracuda

Two species are abundant around the outside of the atoll and are commonly taken by the natives when trolling. The Raroians say that only these two kinds of barracudas occur at Raroia and that TUATAU (Sphyraena helleri) are sometimes poisonous to eat. More definite information on toxicity could not be obtained.

Sphyraena snodgrassi Jenkins.--Maxillary extending to below front of eye. Scale rows about 80. Life colors of specimens from station 62: General color iridescent silver, blue above, with vertical bands along upper side. Top of head blue shading to brown on sides of head. Jaws iridescent bluish-brown. Iris iridescent gold to blue. Spinous dorsal black. Soft dorsal black with tips of anterior rays white. Basal two-thirds of anal fin white; edge of fin with a broad black band. Caudal fin black; tips of upper and lower lobes white; middle of base silvery with a black spot in center. Pelvic fins pale red and hyalin. Pectoral fins dusky white at base shading to black at edge.

Stations: 33(3), 62(2).

Habitat: Common at Raroia. Open water in Garue Pass and over coralliferous outer bench of west side of atoll. Said to be poisonous at times but the natives ate them during the period we were at Raroia.

Raroian name: ONO.

Sphyraena helleri Jenkins.--Maxillary not reaching eye. Distance from pectoral fin origin to pelvic fin distinctly more than postorbital distance. Life colors of specimen from station 56 immediately after capture: General color iridescent silver; blue above. No distinct markings on head. Top of head and tips of jaws black. Iris metallic brassy. Body blue shading to black above. A gold stripe present down side midway between lateral line and ventor. Dorsal fin dusky black distally on anterior rays. Caudal fin dusky black overall. Anal fin hyalin, the anterior soft rays with scattered melanophores. Pelvic fins completely hyalin. Pectoral fin hyalin, first rays dusky black.

Stations: 56(1).

Habitat: Uncommon at Raroia. Taken in open water in Garue Pass.

Raroian name: TUATAU.

FAMILY POLYNEMIDAE

Thread Fins

During the period at Raroia only one specimen of this family was seen. The natives use the family for food but were vague about its distribution and abundance.

Polydactylus sexfilis (Valenciennes).--Pectoral fins with six free filaments ventrally.

Stations: 45(1).

Habitat: Rare at Raroia. Speared on outer reef near Oneroa.

Raroian name: MOI.

FAMILY SERRANIDAE

Sea Basses

This group is second only to the Scaridae as food for the Raroians. Twelve species were taken at Raroia and such intensive collections were made of this family that I doubt that more than one or two species were missed. Despite the fact that several species of Epinephelus are hard to distinguish, the natives are keenly aware of the differences and unerringly name all specimens--young or adult. Almost all species have at least one name. Except for Grammistes, the unidentified genus and Paracenthistius, all species are commonly used for food. The last named fish is poisonous at Raroia and not eaten.

The family is most abundant in holes in the coral on the coralliferous outer bench, in Garue Pass and around lagoon coral heads. The young are abundant on shore reef flats, especially around the outside of the atoll. Cephalopholis argus is by far the most predominant of this family, particularly on shore reefs. Of the eight main marine fish zones (see ecology) the Serranidae are prevalent in all but the surge channels.

The natives spear sea basses with single and four-pronged spears, especially fishing for them along the shore edge and in the inter-islet channels. Serranids readily bite on a hook baited with all kinds of meat. This

method is most successful along the coralliferous outer bench, in Garue Pass and around lagoon coral heads.

Grammistes sexlineatus (Thunberg).--Dorsal fins separate. Distinctive markings yellow and brown longitudinal stripes.

Stations: 11(2), 22(5), 45(2).

Habitat: Moderately common in west shallow inter-islet channels; rare in neighboring regions (tide pools near shore on outer reef flat and lagoon shore reefs); not noted elsewhere.

Raroian name: none.

Variola louti (Forskål).--Pectoral fin with yellow edge. Small red dots over head and body. All fins but pectorals prolonged. Life colors of specimen from station 62: Ground color bright red over head and body, with brilliant vermillion to bluish-red spots. Head covered with spots above horizontal level from lower edge of mouth. Red spots present on upper lip, none on lower. Lower half of head yellow; pale blue behind jaws. Iris red, blackish above, and a narrow black streak below. Body bright red, reddish-black above to pure red below. Body covered with red spots that are paler than the background color; these spots extend ventrally to a horizontal from lower edge of pectoral fin. Belly and breast pure red without markings. Spinous dorsal ground color dusky black with numerous red, purple and blue spots on the rays and membranes. Soft dorsal reddish-black, covered with numerous bright red spots which fade out on posterior edge to pale yellow. Edge of soft dorsal black. Caudal fin reddish-black, middle rays shading to pale yellow at tip. Anal fin reddish-black, three to seven red spots on basal half of each membrane; distal edge of fin shades to black, posterior edge shades to hyalin. Pelvic fins edged in black anteriorly shading to red on second soft ray. Remainder of fin pale red. Pectoral fin broadly edged by a pure yellow band. Remainder of fin shades from black tinged with red to dusky red at base; a few red spots on basal part of fin.

Stations: 33(1), 62(1).

Habitat: Noted in Garue Pass and on coralliferous outer bench; well known to the natives but apparently not abundant.

Raroian name: HOKAKOKA AND MAERE.

Cephalopholis urodelus (Schneider).--Fourteen soft anal rays. Distinct V present on caudal fin that is bordered with black above. Two black spots on top of caudal peduncle. Red spots over side of body. Life colors of 150 mm. specimen from station 61: Head brown, paler on cheeks and opercles. Iris vermillion with a broad black ring in the center which shades out on the anteroventral margin. Lips brown. Upper half of preopercle with orange spots. Occiput and nape brown, with a few dark

brown spots on the side. Body anteriorly brown above shading to red-orange posteriorly and ventrally. Sides of body covered with bright red to orangish-red spots that fade out above anteriorly; breast yellow, orange above pelvic fins. Dorsal fin brightly colored; spinous dorsal with tips of membranes bright red; remainder of fin brown with suffuse orange spots. Soft dorsal with a broad brilliant red horizontal band; remainder of fin brown with two longitudinal series of red to reddish-orange spots. Caudal peduncle superiorly with two black spots. Caudal fin bright red, margins of upper and lower rays hyalin; middle of fin with bright red membranes and paler rays. Anal fin same as soft dorsal except last rays fainter red. Pelvic fins orange-red, shading to pale orange posteriorly and basally. Pectoral fins orange shading to yellow-orange posteriorly.

Stations: 61(2), 66(1).

Habitat: Taken on coral head on east side of lagoon and on shore reef of west side of lagoon. Rare at Raroia, but much more common at Takume.

Raroian name: none.

Cephalopholis argus (Bloch).--Caudal fin rounded. Anal fin with nine soft rays. Body brownish-black with black-ringed blue spots. Life colors of adult from station 62: Head and body dark brown with indistinct narrow vertical brown stripes, particularly evident over anal fin. Head, body and fins covered with close-set blue spots. Head darker brown than body. Iris dusky gold, narrowly pale blue next to iris; a dusky black crescent present above lens. Body solid brown overall. Blue spots evenly scattered over body except sparse below pectoral fin. Spinous dorsal same as body. Soft dorsal solid black shading into brown basally. Dorsal fin covered with blue spots as on body, except more concentrated distally. Caudal and anal fins same as dorsal. Pelvic fins same as soft dorsal except lacking hyalin edge and spots are not more numerous than on body. Pectoral fin basally black shading distally to brown; edge of fin hyalin; basal half of fin covered with numerous blue spots, more concentrated than on body; outer half tinged with red.

Stations: 8(7), 9(3), 10(2), 11(6), 14(12), 20(4), 22(17), 23(4), 28(5), 33(2), 57(2), 60(1), 61(18), 62(3), 65(10).

Habitat: Very abundant throughout the lagoon around coral heads and shore reefs, and in Garue Pass. Young abundant in tide pools near shore, on outer reef flat and in inter-islet channels. Largest adults on coral heads in center of lagoon.

Raroian name: HAPUTU.

Paracanthistius maculatus (Bloch).--General color red without bands. Small black ringed blue spots over head, body and vertical fins. Life colors of specimens from station 52: General color solid brick red over head,

body and caudal fin; reddish-black above. Head with numerous tiny black ringed blue spots. Jaws without markings. Iris gold, narrowly edged in reddish-gold, black anteriorly. Spots present over all of head except jaws. Body with similar spots as on head. Ventrally spots become solid black. Spinous dorsal reddish-black with numerous obscure blue spots. Caudal fin same as body, narrowly edged in white. Pelvic fins reddish-black, first rays black, edge of fin dusky black. Pectoral fins similar to pelvic. Anal fin same as body except for numerous spots narrowly edged in white.

Stations: 19(1), 26(1), 33(13), 42(1), 52(2), 54(2), 60(1).

Habitat: Very abundant in Garue Pass and neighboring regions in deeper water. Moderately common on coralliferous outer bench. Poisonous. Not eaten by natives.

Raroian name: KEKEREVAE (small), TONU (large).

Epinephelus merra Bloch.--General color white with numerous small black spots on head and body. All fins white edged.

Stations: 11(6), 14(16), 20(6), 22(12), 35(1), 47(4), 55(33), 65(1).

Habitat: Almost entirely restricted to inter-islet channels among coral and rocks.

Raroian name: GAREA.

Epinephelus hexagonatus (Cuvier and Valenciennes).--Life colors of specimen from station 44: Head and body brownish white ventrally, green dorsally, covered with large brown spots that do not tend to form lines or saddles. Brown spots present in maxillary groove. First dorsal edged black; basally fin brown with reddish-brown spots. Soft dorsal edged white with a submarginal black line; remainder of fin covered with close-set brown spots. Caudal fin same as body, edged with a white line. Soft anal edged in white; submarginally with a broad black stripe; remainder of fin similar to body; membrane between first two spines hyalin, other spinous membranes dusky black. Pectoral fin pale brown with small blackish spots on rays; basal half of fin with light blue lines around spots. Pelvic fins covered with brown spots; edged white.

Stations: 7(4), 8(3), 9(5), 10(1), 11(8), 12(1), 14(11), 23(5), 28(7), 33(1), 42(2), 44(1), 45(6), 49(7), 50(3), 61(8), 65(4).

Habitat: Abundant at Raroia; occurs where there are hiding places under rock and coral.

Raroian name: VEVE.

Epinephelus maculatus (Bloch).--Coloration mottled over head and body. Black saddle present on caudal peduncle. Lower half of head and body covered with tiny dark spots.

Stations: 7(4), 8(3), 9(2), 22(2), 23(3), 28(5), 31(1), 33(2), 35(1), 42(1), 43(1), 46(4), 47(3), 55(1).

Habitat: Very abundant at Raroia where there are hiding places under rocks and coral. This species and Cephalopholis argus are the dominant sea basses around lagoon coral heads. It is one of the main food fishes of the natives.

Raroian name: TITIRIRI (small), KUFARUFARU (medium), KITO (big), KINAO (fat).

Epinephelus tauvina (Forskål).---Head and body covered with reddish-brown spots. No stripes on dorsal fin. Life colors of specimen from station 43: Ground color overall greenish-white. Head, body and fins covered with reddish-brown spots. First dorsal edged with a dusky brownish-black line. Second dorsal similar except with a very narrow white edge. Caudal fin narrowly edged in white; submarginally bordered by a black band. Anal fin similar to soft dorsal. Pelvic fin edged in brownish-black; first pelvic ray same color as other rays, not white. Pectoral fins similar to caudal fin.

Stations: 11(1), 28(1), 33(2), 43(1), 47(3), 62(1).

Habitat: Moderately common at Raroia. It is most abundant on top of lagoon coral heads among dense algal growth and coral. Scattered individuals are found in inter-islet channels and Garue Pass.

Raroian name: FAKETA.

Epinephalus socialis Günther.---Four black spots present on back. Head, body and fins covered with suffuse small light brown spots. Light area between spots a dull light blue.

Stations: 11(5), 14(14), 16(1), 17(3), 20(1), 22(12), 45(6), 58(9), 65(3).

Habitat: Common in inter-islet channels, Garue Pass, and on outer-reef flat.

Raroian name: KOKOTIKA.

Epinephelus sp. one.---Solid red overall, with oblique white lines in tail. General color a uniform brilliant red. No markings on head and body except for numerous small darker red spots. Iris red, distally reddish-black. Dorsal fin same as body except soft dorsal with numerous red spots. Caudal fin with central region reddish-black; oblique lines above and below through fin pure white; upper and lower rays edged hyalin. Anal fin same as soft dorsal except for dusky black band down middle of fin and pale spots basally on posterior rays. Pelvic fins red, the first soft ray edged in black. Pectoral fins solid red.

Stations: 62(2), 66(1).

Habitat: Rare at Raroia. Taken by hook and line off bottom in Garue Pass and on coralliferous outer bench of west side of atoll.

Raroian name: TUKOROKORO.

Genus one species one.--Characterized by long flowing fins. General color black with numerous blue spots. Coloration of specimen 110 mm. in length from station 13 two months after preservation: Blackish-brown to solid black overall with bright blue spots covering head and body. Iris iridescent dark blue. Body and head with each scale having a blue spot in the center. Branchiostegal membranes brown with blue spots. All fins but pectorals black, covered with closely spaced blue spots. Pectoral fins hyalin.

Stations: 13(1).

Habitat: Only one noted at Raroia on lagoon coral head.

Raroian name: none.

FAMILY PSEUDOCHROMIDAE

Two species were recorded at Raroia and perhaps others will be discovered when the unworked material is examined. The family lives in cavernous surge channels and in hiding places in coral and under rocks in the lagoon. The natives believe they are the young of sea basses and have no name for them.

Aporops bilinearis Schultz.--Two lateral-lines on side of body. No black spot on operculum. Light spots on brown body. Life colors of specimens from station 58, 45 mm. in total length: Head and body uniform brown, shading to pale brown below. Head greenish before eye. Body with suffuse darker brown spots above pectoral fin. Dorsal fins brown at base. Outer unscaled portion pale black, shading to hyalin edge on posterior soft rays. Caudal and anal fins pale black with hyalin edge. Pectoral fins dusky black. Pelvic fins hyalin. In 60 mm. specimens head and body have darker brown spots evenly scattered but without any definite arrangements. Vertical fins dark brownish-black, very narrowly edged in hyalin.

Stations: 17(8), 22(1), 28(1), 57(1), 58(10).

Habitat: Most abundant in cavernous surge channels, hiding deep in cracks and under rocks. Occasional individuals observed in lagoon deep under rocks and coral.

Raroian name: none.

Pseudogramma polyacanthus (Bleeker).--Black spot on operculum. General color mottled brown. Life colors of specimens from station 57: Overall dark brown, irregularly mottled with a darker brown reticulated pattern over all of body and upper half of head. Large dark brown spot on upper edge of operculum. Suffuse brown lines radiate from posterior border of eye. Iris dark brown, lens ringed with gold. Jaws pale except for dusky brown tips. Lower surface of head pale. Membranes of spinous dorsal brown; membranes of soft dorsal brown, fading to pale brown at tips. Caudal fin solid brown. Anal fin brown, fading to pale brown at tips. Pelvic fins dusky brown at base, membranes hyalin. Pectoral fins dusky brown.

Stations: 7(2), 57(2).

Habitat: Observed only in lagoon in same habitat as Aporops.

Raroian name: none.

FAMILY LETHRINIDAE

Mu & Snappers

While only three species of lethrinids appear to occur at Raroia, they are very abundant around the islets inside and outside the lagoon, and provide an important food for the natives. The natives know the lethrinid names without hesitation and are well aware of where they occur around the atoll.

Monotaxis grandoculis (Forskål).--Characterized by three broad solid black saddles on back in life that immediately fade after death. Life colors of specimens from station 61: Head olive grey. Interorbital greyish-yellow. Tip of upper jaw black, tip of lower jaw dusky black. Iris silver, bordered by black above and posteriorly, and by two dusky black spots below. Body with three broad solid black saddles on back that shade out to yellow on mid-lateral region. Between black bands pale blue. Pectoral fin base solid black. Breast and belly dusky olive, blackish between pelvic and pectoral fins. Caudal peduncle dusky yellow. Spinous dorsal dusky black, shading into a pale red margin. Soft dorsal anteriorly like spinous dorsal, but posteriorly pale red to hyalin. Caudal fin basally pale yellow, tips of outer rays pale orange-red, middle rays faintly streaked with black longitudinal lines at middle; otherwise fin hyalin. Anal fin pale red anteriorly, shading to pale yellow posteriorly. Pelvic fins hyalin. Pectoral fins rays pale orange, membranes hyalin.

Stations: 27(1), 31(1), 61(3), 66(1).

Habitat: Very restricted in distribution. The young are almost entirely confined to around lagoon coral heads near the eastern side

of the atoll. The adults are rarely seen in the daytime, but come into the surge channels and onto the outer reef flat at night to feed.

Raroian name: MU.

Lethrinus mahsena (Forskål).---Characterized by a red mouth, by uniform body coloration, and by yellow pectoral fins. Life colors of specimen no. 2306 from station 33: Ground color of body olive brown to grey; edge of each scale (particularly anteriorly and ventrally) darker brown. Entire body colored evenly, back slightly darker. Head brown, squamation on operculum same color as body. Lips reddish in the folds. Inside of mouth bright red. Iris golden brown, variously mottled brown, blue, and silver. Upper edge of eyeball shaded brownish black. Spinous dorsal dusky brown, edged in pale red. Soft dorsal fin yellowish-brown basally, pale red at edge, last rays pale red almost to base. Caudal fin brown, a pale yellow vertical band across middle, edge of fin pale red. Anal fin yellowish-brown, edged in pale red. Pelvic fins with yellow rays; anterior soft rays dusky black; membranes hyalin. Pectoral fin with rays yellow and membranes hyalin.

Stations: 24(2), 33(1), 45(2).

Habitat: Northern, eastern and southern inter-islet channels; abundant in Garue Pass. Prefers channels with swift moving water; occurs in schools. This species is one of the more important food fishes. It is speared under rocks and also caught with hook and line.

Raroian name: TAMURE.

Lethrinus rostratus Cuvier and Valenciennes.---Characterized by a long snout, bright red throat inside mouth, and red dorsal fin. Life colors of specimen from station 60: General color olive white, somewhat greenish, without markings on head or body. Iris silver. Spinous dorsal reddish, shading to brighter red at edge. Each spine with two suffuse brown spots. Soft dorsal pale red, with two suffuse brown spots on each ray, membranes with approximately three large white spots that extend onto the rays. Caudal fin generally pale, same color as body, with reddish posterior edge. Anal fin pale, outer edge of membranes red. Pelvic fins white, outer half of membranes red, tip blackish. Pectoral fins white, membranes hyalin.

Stations: 31(1), 60(1).

Habitat: The natives say this species is common at Raroia although only a few individuals were observed during our study. It is said to be most abundant in deeper water (20-40') in Garue Pass and along the outer reef edge.

Raroian name: MEKO.

FAMILY LUTIANIDAE

Snappers

Seven species of this family were taken at Raroia, approximately half of the species that occur there. More were not taken because of inadequate gear, although considerable effort was expended trying to obtain additional forms. The family is most abundant in deeper water around the outside of the atoll, and along the eastern shore in the lagoon. Seldom are more than scattered individuals observed in the rest of the lagoon. Large schools occur in the closed off inter-islet channels on the east side of the lagoon.

The natives have a different name for each species and use practically all the snappers for food. The large adults of Lutianus bohar are poisonous and natives know within a few inches of length when an individual is poisonous or not. No other lutianids are poisonous, according to the natives.

Lutianus monostigma (Cuvier).--Characterized by a black spot behind pectoral fin on lateral line.

Stations: 11(2), 24(1), 27(1), 30(1), 35(4), 60(1).

Habitat: This is an important food fish at Raroia, widely distributed in deeper water around coral heads and shore reefs. It was only once observed in schools, but individuals were often noted hiding in coral heads and in schools of Lutianus kasmira and Lutianus marginatus.

Raroian name: PUAKI (small), TERO (medium), PARAI (large).

Lutianus kasmira (Forskål).--Characterized by a yellow body with three longitudinal bright blue stripes.

Stations: 35(1), 37(1), 38(3).

Habitat: Entirely confined to the east and northeast side of the atoll in the lagoon. Large schools were noted in incomplete inter-islet channels around coral heads. Only a few adults were observed on eastern lagoon coral heads. Seldom used for food by the natives since they rarely bite on a hook and are difficult to spear.

Raroian name: HUTIHUTI and TOHARE.

Lutianus marginatus (Cuvier).--Characterized by a yellow body with numerous narrow yellow stripes on lower half of sides; caudal and dorsal fins edged black. Life colors of specimens from station 47: Head yellow on gill cover; anterior to squamation grey. Lower scales on preopercle and opercle with light orange spot in the center. Body yellow, dusky on back shading to pure yellow on belly. Caudal peduncle yellow. Spinous and soft dorsal fins with a submarginal black band that becomes darker on the soft dorsal. Fins narrowly edged hyalin. Caudal fin

black, narrowly edged hyalin. Anal fin pure yellow as are paired fins. Lower half of body with yellow-orange on each scale, most intense below and before pectoral fin, forming into longitudinal lines posteriorly to caudal peduncle.

Stations: 24(1), 35(2), 37(1), 38(4), 47(8), 60(12), 65(1).

Habitat: Scattered individuals throughout lagoon around coral heads; abundant in large schools in closed off inter-islet channels around dead coral and beach rock caves. This is an important food fish for the natives and is taken by spears.

Raroian name: MAGU MAGU.

Lutianus gibbus (Forskål).--Life color notes of specimen from station 44: No spots. Red present below on head. Dorsal fin orange as other fins. Head and body dark above, olive brown, shading to reddish below, particularly on throat and head. Indistinct yellow longitudinal lines present on mid-side of body on the middle of each scale row. Fins without markings, all orange. Dorsal brownish except for orange tips. Vertical fins scaled far out on fins.

Stations: 44(1), 47(2).

Habitat: Common off outer reefs of atoll. A few adults noted in lagoon around coral heads and on southern sand flats.

Raroian name: PUAKI (small), TERO (medium), PARAI (large).

Lutianus bohar (Forskål).--Characterized by bright red head and body and blackish fins and back. Black mark behind maxillary. Black axillary spot on pectoral fin. Life colors of specimens from station 33: Head brilliant red tinged with orange, particularly brilliant on underside. Upper half of preoperculum and operculum tinged with green. Top of head from snout to dorsal fin dark reddish-black tinged with green. Maxillary dusky reddish-black where normally hidden by groove. Upper lip dusky reddish-black. Streak behind maxillary dusky reddish-black. Groove before eye bright red. Iris brilliant golden reddish-orange. Tip of lower jaw dusky black. Body reddish-black above shading to brilliant reddish-orange below that in life is often purple, pink or tinged with blue. Belly purplish-red. Spinous dorsal solid blackish-red. Soft dorsal reddish-black, with black edge. Caudal fin bright red, narrowly edged in black. Anal fin red at base, anterior edge black, outer unscaled portion reddish-black. Pelvic fins solid red, outer region of fin anteriorly black, narrowly edged in black posteriorly. Pectoral fins with black spot at upper base; upper half of fin reddish black to solid black at tip; lower half and base red.

Stations: 33(8), 62(1), 63(1).

Habitat: Abundant around outside of atoll on coralliferous outer bench and in Garue Pass. The natives catch them for food with hook and line and occasionally by spear. The large adults called MERO MERO are poisonous.

Raroian name: TAGAU (very small), TATATATA (medium), MERO MERO (large).

Lutianus sp. one.--Characterized by broad black region across caudal peduncle and caudal fin and a red stripe on dorsal fin. Life colors of specimens from station 61: General color of head and body greyish-white, somewhat olive, with a faint greenish tinge. Head without markings, light. Iris gold, orange-gold above. Body tinged with red on breast, belly, and region above anal fin. Caudal peduncle posteriorly covered with a broad black region; caudal fin basally black; posterior edge pale yellow-green to pale black. Dorsal fin edge white, submarginally black; black bordered by a suffuse red longitudinal band that extends through spinous dorsal and ends on last soft rays. Basal portion of spinous dorsal white anteriorly, black posteriorly on each membrane. Soft dorsal basally black. Anal fin red; anterior half edged in white, submarginally with a black and red band. Pelvic fins anteriorly edged white, outer region of first two soft rays black; remainder of fin pale red, most concentrated on anterior rays. Pectoral fins pale-yellow on rays, with upper basal region pale red; membranes hyalin.

Stations: 61(5).

Habitat: Seldom observed around coral heads in lagoon. A small school was hiding in the coral at station 61, a coral head in the lagoon of Teremu Islet.

Raroian name: TAEA.

Aphareus furcatus (Lacépède).--Characterized by brownish-blue-grey ground color, orange pectoral fins, and elongate last dorsal and anal rays. Life colors of specimens from station 62: Ground color brownish, iridescent pale blue and grey mixed together on scaled areas. Head solid brown on unscaled portions. Lower jaw brownish with iridescent light blue. Iris silver distally to gold internally. Dorsal fin yellow-brown, soft rays with faint reddish edge. Caudal fin edged red, remainder pale black. Anal fin bright yellow tinged with orange; posterior rays and membranes pale red, all of fin edged pale red. Pelvic fins pale yellow on membranes; anterior rays pale red, tips of first rays white. Pectoral fins pale orange.

Stations: 62(10).

Habitat: Schools in deep water over edge of outer reefs. The natives occasionally take them by trolling.

Raroian name: TAHAKARI.

FAMILY KUHLIIDAE

Ahole

Only one species recorded at Raroia and the natives say there is only one kind. It is occasionally used for food, but usually discarded.

Kuhlia sandvicensis (Steindachner).--Fifty-five scale rows between opercular margin and base of caudal fin. Caudal fin plain with posterior margin black. Life colors of specimens from station 45: Head and body silver, blackish above. Dorsal fin membranes hyalin basally, dusky black at tip. Caudal fin white with posterior margin black. Anal fin hyalin, except for scattered melanophores medially. Pelvic and pectoral fins hyalin. Iris silver, blackish at posterior margin of lens.

Stations: 16(1), 27(7), 45(7), 58(1), 65(10).

Habitat: Reef flats on west and southwest side of island. Feeds on reefs at low or high tide day and night.

Raroian name: AHORE.

FAMILY APOGONIDAE

Cardinal Fishes

Approximately 12 species of cardinal fishes were taken at Raroia, and probably only a few additional species occur there. All species observed were taken. This group is found wherever there is coral, and is most abundant on the lagoon coral heads and west shore reefs. The cardinal fishes are inconspicuous, usually remaining in the holes in the coral, and are completely ignored by the natives, who have no name for them. All specimens were taken by rotenone, this being the only effective means for collecting them. Very little restrictions of distribution to definite sections of the atoll were observed, nor were they particularly more abundant in one area than another. They prefer the quieter waters of the lagoon and are much less in evidence on the outer reefs or in the inter-islet channels.

The following data for the cardinal fishes have been prepared from only a small part of the total collections, and do not include all the species taken or all the material for each species. While the fishes of this family are eaten in Tahiti and are sold in the central market at Papeete, they are not eaten at Raroia. In Tahiti they are taken by common beach seines on the coral flats next to shore and on the outer reef flat, but seines are not now used by Raroians.

Apogon ceramensis (Bleeker).--Color notes prepared at station 9: Ground color light with a single black streak from tip of snout through eye

to caudal fin. A black spot present above lateral-line on base of caudal fin. Anterior three dorsal spines edged in black. A fine narrow black line near base of soft dorsal rays.

Stations: 9(5), 13(2), 28(1).

Habitat: This species is especially abundant on the tops of lagoon coral heads in shallow water, living in holes in the coral rubble and holes in the sand.

Apogon doryssa (Jordan and Seale).--Distinctive colors orangish red, particularly at the fin bases. No markings except for scattered melanophores on mid-dorsal line, mid-lateral region of caudal fin base, and on head.

Stations: 7(3), 9(4), 12(1), 58(1), 61(1).

Habitat: One of the most abundant species at Raroia, occurring practically wherever the family is found.

Apogon aroubiensis Hombron and Jacquinot.--Distinctive colors dark brown with light blue stripes. Stripes becoming reddish on head. Fins reddish brown with suffuse blackish brown stripes. Color streaks do not continue on caudal fin. Life colors prepared from specimens of station 57: Head and body with blackish brown longitudinal stripes separated by pale blue lines. Lines on head become narrow and pure white. Brown stripes become reddish. Iris pure silver with greenish tinge. Spinous dorsal with rays dusky black, reddish on posterior margins of each spine. Soft dorsal blackish brown at base, distally pale red. Caudal fin with median rays dusky, remainder of fin pale yellow. Anal fin with brownish black base, fading out anteriorly. Remainder of fin pale red. Pelvic fins red basally shading out to hyalin distally. Pectoral fin pale red at base shading out to hyalin distally.

Stations: 7(6), 28(3), 57(2).

Habitat: Abundant at Raroia, particularly on the lagoon coral heads.

Apogon isostigma (Jordan and Seale).--Distinctive colors consist of black spot on operculum; approximately nine longitudinal rows of black spots. Life colors of specimens from station 49: Head and body general color dark brown. Head with two black lines radiating from posterior edge of eye. Iris pale yellow. Black spot on operculum narrowly edged in white. A longitudinal dark brown line above and below the opercular spot. Each scale on body tends to have a black spot at its base, forming longitudinal lines. First dorsal solid brown. Second dorsal brownish at base and orangish for most of fin. Membranes hyalin distally. Caudal fin very dark, brown to blackish, rays orangish. Upper middle and lower middle rays pale orange at edge.

Anal fin rays orangish-brown, membranes brownish, darkest medially. Pelvic fin with orange-brown rays and pale brown membranes. Pectoral fin with pale reddish brown rays and hyalin membranes.

Stations: 28(4), 49(4).

Habitat: Observed only in the lagoon where it is moderately common.

Apogon bandanensis Bleeker.--Distinctive colors silver with dusky vertical stripes hardly evident. Conspicuous band across caudal peduncle; another from lower edge of eye. Tip of first dorsal dark.

Stations: 7(16), 9(3), 13(1), 17(1), 23(16), 49(3).

Habitat: Very abundant on lagoon coral heads.

Apogon frenatus Valenciennes.--One of the largest cardinal fishes. Third dorsal spine longest. Black streak across soft dorsal and anal. Black blotch on caudal peduncle.

Stations: 7(1), 9(4), 27(1), 28(6), 42(1), 65(1).

Habitat: Solitary individuals around coral heads.

Apogon auritus Valenciennes.--Black spot on operculum bordered in white. Body head, and fins reddish-orange with about eight suffuse vertical bands on body.

Stations: 7(5), 13(1).

Habitat: Moderately abundant around lagoon coral heads.

Apogon sp. one.--Apparently this is a very small species. Ground color chocolate brown overall. Head with two oblique dark brown stripes. Spot on operculum. Fins blackish. First dorsal with a black spot on posterior membranes edged in white. Edge of soft dorsal, soft anal, and caudal edged in white. Pelvic fins black. Pectoral fin with a brownish-black vertical stripe basally. Each scale row on body darker brown centrally, tending to form longitudinal stripes.

Stations: 17(3).

Habitat: This species lives in the sea urchin holes on the coral-line ridge, outer reef west side of atoll.

Paramia quinquelineata (Cuvier).--Canines in upper jaw. Six bands on each side, including mid-dorsals and mid-ventrals. Black spot at caudal fin base. Colors of specimens from station 23 one month after preservation: Stripes brownish-black. Background color yellowish-white, tinged with silver. Iris brownish-black above on border, remainder

silvery-white. Fins hyalin except for dusky black on first spines of dorsal fin and outer caudal rays. Yellow particularly concentrated around caudal spot.

FAMILY KYPHOSIDAE

Rudder Fishes

Only one specimen was seen the entire period at Raroia, although the natives claim this group is rather common around the atoll.

Kyphosus sp. one.--Characterized by two longitudinal black bands above and below eye. Body descaled but apparently upper half of body solid black, bordered by a golden longitudinal band. Breast and belly pure white. Dorsal and anal fins solid brown. Pectoral fins dusky brown. Pelvic fins brownish red anteriorly, pale yellow on last rays. Caudal fin brown.

Stations: 45(1).

Habitat: Not known. A native speared the one from station 45 along the outer reef in a surge channel, but the natives were vague as to where it occurred.

Raroian name: TAHAKARI.

FAMILY SIGANIDAE

One species was taken at Raroia which the natives say is uncommon. None were observed in the field. Their paucity at Raroia is strange, since the group is so abundant at Tahiti, forming an important native food there. The natives eat them at Raroia, but seldom find them.

Siganus sp. one.--Body bluish brown. Head and body covered with yellow spots. Fins pale, marbled brown. Colors of specimen from station 64: (specimen described before preservation but not seen alive). It appears that the ground color is bluish-brown. Head and body covered with closely spaced yellow spots. Iris ringed with gold, dusky black, and pale blue rings. Head bright blue, as are breast and belly. Spinous dorsal and spinous anal with brown rays; membranes marbled brown and hyalin. Soft dorsal and anal with rays brown and membranes hyalin. Caudal fin brown with a broad white posterior edge. Pelvic fin rays brown; membranes blue with pale brown spots. Pectoral fins with pale yellow rays and hyalin membranes.

Station: 64(1).

Habitat: Uncommon at Raroia. Speared along shore on west side of lagoon.

Raroian name: MARAVA.

FAMILY PEMPHERIDAE

Catalufas

The one species taken at Raroia was found only in deep cavernous surge channels next to the coralline ridge. While only a few would be in each channel they were always found in this type of habitat. The natives have no name for this group.

Pempheris otaitensis Lesson.--Pectoral fin base and first rays of dorsal fin black. General head and body color brassy. Life colors of specimens from station 45: General color brassy shading into black dorsally and along anal fin origin. Iris silver. Dorsal fin with anterior edge black and upper third of anterior rays black; remainder of basal portion of fin white shading into hyalin at tip. Caudal fin with upper and lower rays black, tips of all rays black. Base of caudal rays pale black, middle third of fin white. Anal fin black at base, dusky white on first rays and middle third of fin, tips of all but first rays black. Pelvic and pectoral fins pale; scattered black pigment spots on pelvics but none on pectorals.

Stations: 45(5).

Habitat: Typical of deeper cavernous surge channels 20-30 feet deep in region of Oneroa.

FAMILY CIRRHITIDAE

Hawk Fishes

This family is typical of the surge channel zone and rarely was found outside this area at Raroia; and then only at the fringes of this habitat. Eight species were taken, and it is doubted that other species occur at Raroia, except the genus Cheilodactylus which was observed around lagoon coral heads, Cirrhitus pinnulatus was far more abundant than all other cirrhitids combined and occurred in all surge channels. At least this species is nocturnal, coming onto the coralline ridge and outer edge of the reef flat to feed at night, even at low tide. Great numbers can be seen on the reef edge either at low or high tide at night, and are almost as numerous as

the squirrel fishes. The natives will eat Cirrhitus pinnulatus, but usually do not take them. They know little about the other cirrhitids and rarely see them. The natives have a general name for all cirrhitids--PARATUKI, but the "real PARATUKI" is Cirrhitus pinnulatus.

Cirrhitids live in cracks in the coral and surge channel walls and under rocks on the bottom of the troughs. Except when affected by poison, not a single individual will be seen when observing in the daytime by skin diving or look box. At night when lights are directed down into the channels hundreds will often be seen moving about on the bottoms of the troughs.

Cirrhitus pinnulatus (Schneider).--Life colors of specimens from station 58: Head and body with reddish-brown spots. Head with a light blue background color from snout posteriorly to opercular edge below eye. This region has longitudinal series of orange-brown lines, irregularly arranged and wavy. Upper half of head colored and marked the same as body. Iris black, golden red anteriorly and posteriorly. Lips and lower jaw crossed by black mottled lines; otherwise lower section of head pale yellow to greenish-yellow. Body with a spot extending ventrally to a parallel from lower edge of pectoral fin. The region above is mottled with large brown blotches, which vaguely tend to form bands. Breast and belly white. Region before pectoral fin spotted like upper half of body. Spinous dorsal edged hyalin. Tufts at tips of fins white. Base of dorsal fin dusky red. Middle of membranes with a longitudinal series of dusky red spots, one in each membrane. Remainder of fin pale yellowish-brown. Soft dorsal colored same as body. Rays with oblique series of three or four reddish-brown spots that basally continue on the membrane. Caudal fin rays with four or five reddish-brown spots that extend slightly on the membranes. Upper and lower rays yellowish. Anal fin with 3-5 reddish-brown spots at base; base of fin yellow to dusky red anteriorly. Pelvic rays yellow to pale orange; hyalin at tip; membranes hyalin. Pectoral fins mottled like body at base; one or two series of red spots on middle of rays. Membranes hyalin.

Stations: 17(30), 22(1), 26(56), 45(13), 58(42).

Habitat: This species is the most abundant cirrhitid in the surge channels, each trough usually having approximately 100 young to adults. At night it comes up on the coralline ridge to feed; it even does this at low tide when it flops around from pool to pool between waves. The natives will eat this species but do not prefer it over other fishes.

Paracirrhites forsteri (Schneider).--Side of body with pale longitudinal stripe. Large black spots on upper side of body. Head reddish. Differs from typical forsteri by lacking black band above white stripe.

Stations: 17(1), 22(1), 26(1), 45(4).

Habitat: There are usually 2-6 individuals in each surge channel on the west side (most specimens were seen in deeper water from 10-25', and none were collected in less than 12' of water).

Paracirrhites cinctus (Günther).--Characterized by vertical brown bands on body. Life colors of specimens from station 58: General color light brown with brown markings. Head brown above fading to pale brown below. Head orangish-brown on snout with an orange-brown band from eye to upper jaw. Lips dusky brown, upper lip black at symphysis. Iris golden red, dusky black around anterior upper and lower sides. Body with five slightly oblique broad vertical brown bands that are darkest dorsally. Breast dusky brown. Belly white. Spinous dorsal evenly pale brownish-black, tip hyalin. Soft dorsal brownish-black at base, rays dusky black; outer portion of membrane hyalin. Caudal fin rays dusky black. Membranes hyalin. Anal fin with dusky reddish-black rays, membranes hyalin at tip. Pelvic fin rays pale orange-brown across middle, membranes hyalin. Pectoral fin rays dusky brown, tinged with red; lower rays pale black. Membranes hyalin.

Stations: 26(4), 45(7), 58(6).

Habitat: This species is found only in surge channels that are more protected. Rather rare at Raroia, being found in only certain surge channel area.

Paracirrhites arcatus (Cuvier).--Supraocular loop reddish-orange. Yellowish-orange to reddish-orange stripe extending down side of back.

Stations: 17(5), 26(1), 58(1).

Habitat: Moderately rare. Only taken at the deeper open end of the surge channels. All of the field observations note that they were seen hiding in cracks on the side of the channels, blending closely with the encrusting algae.

Paracirrhites sp. one.--Characterized by a general dark purplish-brown color and a pure white spot on body behind pectoral fin. Life colors of specimens from station 45: Ground color over head and body a dark purplish-brown. Head color uniform except darker behind eye, on interorbital and at preopercular margin. Lips reddish. Gill membranes black medially at throat. Body purplish-brown with dark brown spots--irregular above, smaller and arranged in longitudinal rows below. A pure white spot covers parts of 9 scales and all of 2 lateral line scales at 16th and 17th lateral line scales, behind and above pectoral fin. Body coloration extends half way out the caudal fin. Spinous dorsal fin brownish-black with reddish-brown spots extending up to membranes. Soft dorsal with body coloration and spots on scales at base; remainder of membrane hyalin; soft rays brownish-black. Caudal fin with posterior third of membranes hyalin. Rays brownish to brownish-black at tips. Anal fin with spines and rays brownish-black. Membranes of soft dorsal black anteriorly, hyalin for posterior membranes. Pelvic fins with rays brownish black, membranes hyalin. Pectoral fin with upper branched rays red; lower simple rays light brown; membranes hyalin.

Stations: 45(3), 58(1).

Habitat: Rare at Raroia. All individuals were taken in narrow surge channels at 8-10' depth. The natives have never seen this species before and apparently it lives deep in the cracks in the coral.

Paracirrhites sp. two.--This species is similar to arcatus but lacks the broad white body band and the outer caudal rays are prolonged. Life colors of specimens from station 66: overall color solid brown. Head not lighter. Head with reddish-orange nostrils tipped with brown, 3 orange-red bands at lower opercular margin that may be divided into two spots; supraocular loop orange-red, narrowly edged with black and blue lines. Inside of loop same brown as remainder of head. Iris narrowly gold to metallic red next to lens. Outer portion dusky purple to black. Spinous dorsal fin brown, shading to narrow black edge. Middle of membrane brownish-red to reddish-orange. Soft dorsal reddish-brown on basal half, outer half of membranes hyalin. Rays reddish-brown to orange-red distally. Caudal fin edged in black dorsally and ventrally. Upper and lower prolonged rays orange-red, shading to more brownish-red and reddish-orange on middle rays. Membranes uniform dusky black. Anal and pelvic fins brown. Pectoral fin brown, upper rays tipped with red.

Stations: 66(2).

Habitat: Only a few specimens were seen in the bottom of surge channels.

Cirrhitoides bimacula Jenkins.--This is a small hawkfish with a pointed snout, two distinctive black spots and reddish-brown vertical stripes.

Stations: 17(1), 58(1).

Habitat: Uncommon at Raroia, preferring the narrower, deeper surge channels. Apparently it lives under rocks on the bottom of the channels.

Genus (undet.). sp. one.--Nothing like it in Fowler (1928), Schultz (1943) or Tinker. Overall a brilliant solid red, including eye. Interorbital and postorbital region blackish. Upper half of body blackish, as are posterior spinous dorsal rays. Tips of last soft dorsal rays blackish. Tips of caudal rays blackish. Outer portion of soft anal rays blackish. Tips of pelvic rays blackish. Pectoral fins solid red. Life colors of specimen from station 66, 75 mm. in standard length: Brilliant solid red in life. Head blackish on symphysis of lips, over top of head across snout to back; eye broadly ringed with reddish black; median ventral region dusky reddish-black. Remainder of head red. Iris golden red. Body solid black at base of dorsal fin shading to red in region of lateral line. Remainder of body red. Spinous dorsal black with the outer half of the membranes tinged with red; soft dorsal with outer half solid red and basal half solid black. Caudal fin

bright red, same as body, with tips of lower rays dusky black. Anal fin with the outer posterior membranes shading to dusky black. Pelvic fins solid red; membranes shading to dusky black distally. Pectoral fin solid red.

Stations: 17(1), 66(1).

Habitat: Only two specimens were seen at Raroia; one in a surge channel and the other in a scoured out trough lined by dense coral in Garue Pass. Both specimens were in about 20' depth of water and apparently hide in cracks in the coral. Their brilliant red color stood out above all else and it is probably a rare species at Raroia.

FAMILY CHAETODONTIDAE

Butterfly Fishes

Sixteen species of this family are known to occur at Raroia, and I doubt that more than one or two other species exist there. Fifteen species were taken and are reported upon; an additional unidentified form was seen in deep outer reef surge channels, but was not obtained. Only a few butterfly fishes are actually common at this atoll; most forms are rare, either being markedly restricted to a certain part of the atoll, or widely scattered with only one or two existing at any particular locality. Three species, Chaetodon setifer, C. trifasciatus, C. lunula, are common at Raroia in the lagoon. The remainder of the species are much less abundant, often only a few occurring at a particular locality. Butterfly fishes are abundant on the outer reef flat (especially C. setifer) but do not go into the surge channels and deeper water. Only C. quadrimaculatus, Centropyge flavissimus and an unidentified Chaetodon somewhat like C. reticulatus, were observed in the surge channels; never more than one or two were seen at any locality. The greatest concentration of butterfly fishes is on the shore reefs in Garue Pass to a depth of about 15'. Only a few chaetodontids were observed below this depth in the Pass. In the lagoon butterfly fishes will school around the coral heads to a depth of 25-30 feet, but rarely are seen below this depth.

The natives call all members of this family KORAI, but have additional names for a few of the species. None are of use to the natives, since they do not eat them. Just why only certain species (some relatively rare) should have particular names, and other equally distinctive species not, I could never find out. I would guess that originally each species of chaetodontid had its own native name, and now the natives know only a few of these original names.

Heniochus permutatus Cuvier.--Three vertical black bands on body. Fourth and fifth dorsal spines elongate. Life colors of specimens from station 61: Head with a longitudinal black band on top of lips and snout, fading out on interorbital. Snout and interorbital region yellow. Underside of

head pure white in life, faintly yellow in preservative. Iris gold. Vertical bands on head and body brownish-black to black. First band through eye lighter above than below, solid black around eye. Second vertical band solid black distally, shading to brownish-black on middle of side. Outer half of spinous dorsal hyalin with tips of rays white. Second band extending from membranes of third to fifth dorsal spines; ventrally covering all soft anal rays. Third vertical band mostly on base of soft dorsal, covering basal half of fin and extending suffusely forward to sixth spine. Caudal peduncle crossed above by a brownish-black saddle. Anal fin edged hyalin on anterior and posterior rays. Longest rays black at tip. Pelvic fins solid black. Pectoral fins hyalin. Area on body not covered by dark bands, pure white.

Stations: 23(1), 28(1), 60(1), 61(2), 66(5).

Habitat: Abundant around the sides of lagoon coral heads and on the inner face of lagoon shore reefs. It has the striking habit of swimming upside down on the ceilings of caves or overhanging coral shelves. Most abundant on western shore reefs. This species is always seen in schools, seldom swimming individually. Practically all specimens had to be speared since they avoid rotenone.

Raroian name: KORAI.

Megaprotopon strigangulus (Gmelin).--Characterized by V-shaped lines on sides of body. Life colors of specimen from station 61: Head and body pale white to greyish-white above. Head with solid black band through eye that is narrowly continuous across interorbital, and broadly continuous across isthmus and breast; black band bordered by a white line which in turn is faintly bordered by yellow. Top of snout with a yellow saddle behind upper lip. Lower jaw yellow on each side. Otherwise upper part of head slate grey; nape between black band and dorsal fin orange. Iris silver to yellow, dusky black above, and suffuse black posteriorly and below. Body with approximately 22 V-shaped lavender lines that become smaller and closer together posteriorly, as the scales become smaller and closer together. The lines curve abruptly posteriorly above and below. Dorsal fin orange, fading out on scaled basal portion. Edge of last three or four spines and edge of soft dorsal narrowly hyalin with a submarginal black line. Caudal fin black, shading to orange on caudal peduncle; abruptly yellow posteriorly and yellow-orange on upper and lower edges; yellow bordered by a vertical black line; edge of fin hyalin. Anal fin yellow-orange, edge same as soft dorsal. Pelvic fins pale yellow. Pectoral fins hyalin, upper basal area yellow, distally rays narrowly edged black.

Stations: 13(1), 23(2), 28(5), 49(1), 61(8).

Habitat: In lagoon on coral heads and shore reefs, but rather un-

common. Usually only scattered individuals seen, except on a few eastern coral heads (such as station 61) where they are moderately abundant. Rarely taken by rotenone; most specimens speared.

Raroian name: KORAI

Chaetodon ornatissimus Cuvier.--Black band through eye extending onto breast. Oblique orange bands present on body. Life colors of specimens from station 33: Solid black vertical bands present on head. Grey patch anteriorly across interorbital. Lower jaw grayish-black. Iris yellow, with a vertical black band. The black band through the eye is bordered by bright yellow. Body pure yellow on breast and belly, dusky yellow above on nape; otherwise body and caudal peduncle white to grey ventrally and on vertical fins. Sides of body with approximately six oblique bright orange bands bordered by suffuse black. Dorsal fin basally with body coloration. Unscaled edge basally black. Spinous dorsal yellow. Soft dorsal yellow with black edge. Caudal fin with vertical black bands near base and submarginal to edge of fin; region between black bands yellow or with a vertical yellow line. Anal fin similar to soft dorsal except for a broad dark brown band bordering basal black band next to body. Posterior edge of fin hyalin. Dark brown band shades to orange at posterior edge. Pelvic fins pure yellow. Pectoral fin rays pale yellow, membranes hyalin.

Stations: 66(4).

Habitat: This species is abundant only on the shore reefs in Garue Pass. The only other individuals were seen on "Makoto" coral head (see station 43). They live at a depth of 5-10' in dense actively growing coral. Never taken by rotenone despite repeated attempts. All specimens speared.

Raroian name: KORAI.

Chaetodon setifer Bloch.--Distinctive markings consist of a black spot on soft dorsal, a broad black band before eye and oblique lines on body. Life colors of specimens from station 61: general color white anteriorly and yellow-orange posteriorly. Head white, except for broad black band below eye; suffuse pale band extending above eye and yellow lines extending across inter-orbital. Band below eye bordered by white line anteriorly, continuous below, but not extending on breast. Gill membrane medially with a longitudinal dusky black line. Lips dusky black. Body with five complete bands extending obliquely downwards and forward; eight complete bands extending obliquely upwards; two or three separate V-shaped bands present. Below pectoral fin are two incomplete lines. All of these lines on body are lavender, becoming broader and yellow-orange on dorsal fin. Posterior part of body yellow-orange. Dorsal fin with membranes and spines dusky yellow, edged in darker brown, shading posteriorly to a black edge. Dorsal fin filament yellow-orange. Posterior edge of fin black. Large solid black spot present

on soft rays behind filament. Caudal fin yellow-orange. Middle of fin with a vertical yellow band bordered by narrow suffuse brownish-black lines; posteriorly there is a narrow brownish-orange band that narrows to a line above and below; edge of fin hyalin. Anal fin with a broad yellow-orange band following contour of fin. Submarginally there is a narrow black line bordered posteriorly by a narrow white line. Pelvic and pectoral fins hyalin.

Stations: 9(2), 16(1), 22(3), 23(6), 27(1), 28(6), 37(2), 38(3), 45(1), 49(2), 50(1), 52(1), 60(3), 61(4), 65(3).

Habitat: This is one of the most abundant species at Raroia, occurring in great numbers on the lagoon coral heads, shore reefs, and outer reef flat. Specimens easily taken by rotenone.

Raroian name: KORAI.

Chaetodon trifasciatus Mungo Park.--Life colors of specimens from station 57: Head with a narrow black stripe through eye from before dorsal origin to mid-ventral line. This stripe bordered by a bright yellow band. Below eye the yellow bands are almost as wide as eye. Above eye these bands are narrow, the anterior yellow stripe shading into orange. Posterior band bordered by yellow-green. Both above and below eye, yellow band posteriorly bordered by narrow light blue line extending entire length, bordered by a brownish-black vertical line. Front of head yellow-grey to black, margin of upper lip black. Operculum yellowish-brown. Midline of nape before dorsal fin orange-brown. Iris black above and below; solid yellow otherwise. Body shading from a pure yellow anteriorly on belly to a purplish-orange posteriorly. Longitudinal stripes on body purple. Spinous dorsal white distally to pale yellow basally. Soft dorsal with an elongate tear-drop shaped black band extending from caudal peduncle onto base of soft dorsal fin; soft dorsal pale at edge; middle of fin crossed by purplish-black lines; fin dusky yellow between lines. Caudal fin crossed in middle by a vertical black line bordered by yellow-orange anteriorly and yellow posteriorly; remainder of fin pale; base of fin white. Anal fin basally with a black club-shaped line bordered by pure yellow that extends forward anterior of anus. Edge of soft fin yellow, bordered by dusky black that shades into reddish-orange. Pelvic fins pure yellow. Pectoral fins hyalin, with a bright yellow base.

Stations: 7(1), 9(2), 13(1), 22(1), 23(16), 28(9), 37(1), 42(10), 49(4), 57(1), 61(10), 66(2).

Habitat: This species is the most abundant butterfly fish at Raroia, occurring in great numbers in the lagoon on coral heads, shore reefs and also on the outer reef flat. Specimens easily taken by rotenone.

Raroian name: KORAI.

Chaetodon lunula (Lacépède).--Most distinctive marking is a V-shaped black band on forehead. Life colors of specimens taken at station 47: Head with a solid black band through eye, bordered dorsally and posteriorly by equally large broad white saddle. Remainder of head yellow-orange. Iris black, narrowly ringed at lens by dusky gold. Black band through eye narrowly bordered anteriorly by pale blue. Body above with a V-shaped black band anteriorly, which is interrupted dorsally in practically all specimens. This V is a brownish black wedge, bordering white and orange above eye. Area between wedge and coloration around eye is orange. Middle of body with approximately 11 red-orange bands curved obliquely upward. These bands extend dorsally to body edge and slightly onto soft dorsal fin. Below pectoral fin are approximately 11 red to reddish-orange spots which have no connections to oblique bands. Lower part of body shading to yellow on belly, superiorly shading to brownish-yellow. Caudal peduncle crossed by black band that extends narrowly upward and forward onto dorsal fin. Black band bordered anteriorly on body by bright yellow stripe. Spinous and soft dorsal bordered by broad black band extending to upper angle of soft dorsal. Remainder of spinous dorsal yellow. Soft dorsal with yellow band bordering black that ends on posterior edge of fin. Caudal fin yellow with vertical orange band across middle and a submarginal black band. Edge of fin broadly hyalin. Anal fin edged in broad black line and an orange submarginal line. Pelvic fins yellow. Pectoral fins basally yellow, hyalin for outer ½ of fin.

Stations: 22(2), 23(1), 28(1), 44(1), 45(1), 47(5), 60(3), 61(1), 65(1).

Habitat: One of the most abundant butterfly fishes at Raroia, occurring in the lagoon on coral heads and lagoon reefs; scattered individuals on outer reef flat. Specimens taken by spears and rotenone.

Raroian name: KORAI MU or KORAI TIKAMU.

Chaetodon citrinellus Cuvier.--Distinctive colors consist of a black stripe through eye, numerous blue spots on body, and no marks on caudal region. Life colors of specimens from station 55: Ground color solid yellow. Head dusky brown on snout shading into light blue below horizontal level from mouth. Vertical stripe through eye solid brown to blackish-brown. Iris gold to greenish-gold, brown above and below. Remainder of head brownish-yellow. Stripe below eye not bordered by distinct color bands. Above eye stripe bordered by narrow suffuse band of light blue. Body overall yellow, slightly greenish, though in life bright yellow. Spots on middle of side metallic blue, shading ventrally, dorsally and posteriorly into solid orange spots. Spots on caudal peduncle solid orange. Dorsal fin yellow-orange, posterior soft rays with numerous orange spots. Anterior dorsal spine dusky black, gradually becomine confined posteriorly to a submarginal black line that continues to upper angle of soft dorsal fin. Last dorsal rays yellow-orange at tip. Caudal fin bright yellow-orange, basal 2/3 of rays with numerous

orange spots. Anal fin edged in black. Black bordered anteriorly by a pure yellow band. Remainder of fin orangish-yellow with orange spots posteriorly. Pelvic fins white, tinged yellow-green. Pectoral fins pale yellow-orange.

Stations: 55(2), 57(1), 61(1), 66(1).

Habitat: Rare at Raroia. Pairs were occasionally seen on the western shore reefs in the lagoon (practically always at the mouth of inter-islet channels) and extremely rarely on lagoon coral heads. Never observed outside the lagoon. All specimens were taken with spears.

Raroian name: KORAI.

Chaetodon reticulatus Cuvier.--Characterized by 12 dorsal spines, black pelvic fins, and the presence of white spots on a black body. Life colors of specimens from station 47: Head with a broad black band through eye bordered by yellow. Snout black except for dark grey immediately before upper part of eye. Posteriorly head grayish-white. Iris grayish-white, a vertical black line at anterior border of eye. Body anteriorly grayish-white; belly black before pelvic fins bordered dorsally by yellow streak. Posterior area of body black; edge of each scale solid black, middle of scale grayish-white bordered by gray-black. White spots on scale larger anteriorly, tiniest near caudal peduncle; caudal peduncle solid black. Spinous dorsal white to gray. Soft dorsal gray anteriorly to black posteriorly. Edge of soft dorsal hyalin, bordered by black line at posterior angle. Caudal fin basally black, its outline lunate. Edge of fin hyalin, bordered by two black lines vertically on middle of fin. Anal fin basally with tiny light gray spots. Most of fin solid black. Soft anal edge hyalin. Pelvic fins solid black. Pectoral fins hyalin.

Stations: 45(1), 47(2), 66(4).

Habitat: Very rare at Raroia except on reefs in vicinity of Garue Pass, west side of atoll. Found in association with C. ornatissimus. All specimens taken by spears; it always escaped rotenone.

Raroian name: KORAI.

Chaetodon facula (Bloch).--Distinctive markings are two vertical black bands on body and a black spot on caudal peduncle. Life colors of specimens from station 58: Head brownish-orange. Band passing through eye black; band narrow above eye. Iris yellowish-black, black above and below. Body with two broad black bands superiorly, shading out on level with pectoral fin. Ground color before hind edge of second black band bluish-white to pure white. Black bands extend on base of dorsal fin. 16 oblique pale black lines present on middle of side. Black band on head not edged in another color band. Operculum bluish-white, same as

body. Ground color behind vertical from last body band abruptly solid yellow-orange. A black saddle is present at caudal fin base across lower side of caudal peduncle. Spinous dorsal yellow. Soft dorsal fin solid yellow-orange, brownish at tips above upper angle. Caudal fin edged hyalin with submarginal brown vertical lines; remainder of fin yellow-orange. Near base of fin are six reddish-orange spots in a vertical row. Soft anal yellow-orange, narrowly edged in orange before outer angle. Two faint submarginal black lines on middle of fin. Pelvic fins and pectoral fins white.

Stations: 11(2), 23(8), 28(5), 58(1), 61(2), 65(1).

Habitat: Scattered over entire atoll lagoon wherever there is coral growth but not common at any locality. Rarely individuals were observed on outer reef flat, but never seen in surge channels. Very seldom taken by rotenone; most specimens speared.

Raroian name: KORAI KEKE.

Chaetodon unimaculatus Bloch.--Distinctive markings a black spot on back and a black ring on caudal peduncle. Life colors of specimen from station 66: Head grayish-white, dusky on top of snout. Broad black line extending through eye; this line not bordered by other colored bands, continuous across breast. Iris blue, broadly black above and below. Body with a large round black spot in region of lateral line, suffusely bordered by a broad white ring. Upper section of body yellow, lower part white tinged with blue. 6 oblique yellow lines present above pectoral fins that are edged with brown. Dorsal fin solid yellow; soft dorsal edged white with a vertical black band above caudal stripe. Black band on dorsal preceded by a gray stripe. Caudal fin white at base; caudal rays hyalin. Anal fin solid yellow, marked like soft dorsal except for gray band. Pelvic fin solid yellow. Pectoral fin hyalin.

Stations: 66(1).

Habitat: Very rare. Two specimens seen in lagoon: one on coral reef next to shore in Garue Pass; one on "Makoto" coral head among dense coral growth (see station 43).

Raroian name: KORAI.

Chaetodon bennetti Cuvier.--Distinctive markings consist of a black spot bordered in blue on middle of side of body and of two blue lines on lower part of side. Life colors of specimens from station 61: Overall solid yellow tinged with orange. Head with brownish-black band through eye, that is narrowly separated across nape and ends ventrally at opercular margin. Black line yellowish in center and narrowly edged solid black on each side. Eye band bordered by a blue line anteriorly and posteriorly. Front of head with a dusky brown line on top of snout from upper lip to interorbital. Operculum with continuation of vertical

blue line that is mainly on body. Body with solid black spot on upper part of side that is ringed with a blue band and a narrow suffuse black line. Lower side of body with two oblique blue lines; the lower line is suffusely edged in black. The upper line is suffusely edged in black at the upper end only. Another faint blue line extends vertically from caudal peduncle to base of anal fin. Caudal peduncle with a dusky brown saddle near end of dorsal fin. Dorsal and anal fins same yellow color as body. Caudal fin mostly hyalin, basally yellow. Pelvic fins yellow. Pectoral fins yellowish at base, otherwise hyalin except for fine black edge to rays distally.

Stations: 61(1), 65(1).

Habitat: Very rare. Specimens taken were the only ones observed, except for an adult seen at station 42.

Raroian name: KORAI.

Chaetodon quadrimaculatus Gray.--Characteristic markings a broad black saddle on back with a brilliant white spot in the center. Life colors of specimens from station 47: Head before eye yellow. Vertical band through eye yellow-orange bordered by brownish-black lines anteriorly and posteriorly. Posteriorly head pale blue to dusky yellow. Body solid black above shading into longitudinal brown spots below. Middle of back with a brilliant white spot that is the most distinctive marking of this fish as it swims in the water. Another similar white spot is present in a finger of yellow-orange that extends dorsally into the black coloration beneath anterior part of soft dorsal. Below pectoral fin body pure yellow. Spots do not continue ventrally on body. Band across caudal peduncle brownish-black. Spinous dorsal yellow-orange for outer part of fin, brownish at base. Posterior spines black for most of their length; then blue bordered narrowly by black; tips of membranes yellow-orange. Soft dorsal basally black to brownish-black. Anteriorly a pale blue line narrowly edges the black. Caudal fin yellow-orange with a narrow hyalin edge. Anal fin yellow-orange with a blue line through spines and rays starting from base of first spine to outer $\frac{1}{4}$ of soft anal fin. Blue line narrowly edged in black. Pelvic fins solid yellow-orange. Pectoral rays pale yellow, longest rays dusky black at tip; membranes hyalin.

Stations: 42(1), 47(1), 58(1).

Habitat: This striking species is rare at Raroia. Approximately six specimens were seen during the entire summer, both in the lagoon and surge channels of the outer reef. All three specimens were taken by spears. They completely avoided rotenone. Never more than two were seen at the same locality.

Chaetodon ephippium Cuvier.--Characterized by black ovate patch on body and a long filamentous soft dorsal ray. Life colors of specimens from

station 61: General ground color pale greyish-white tinged with lavender. Underpart of head solid orange. Eye with a short narrow black line above and below. Iris silvery white. Upper border of eyeball with a black line that continues dorsally; eyeball orange anteriorly and posteriorly. Body with prominent black ovate spot dorsally that covers most of dorsal fin. Black bordered by a broad white band except for upper and posterior margins. Approximately seven longitudinal lavender stripes present on lower side behind pectoral fin. Breast solid orange, same color as head. Membranes of spinous dorsal with a longitudinal black line that is bordered by hyalin shading to yellow tips. Soft dorsal above black area hyalin, shading into yellow. Caudal fin hyalin, the upper and lower rays orange. Caudal peduncle crossed by an orange ring that extends anteriorly and ventrally. Anal fin same as body for most of fin; edge narrowly black. Middle of fin with an orange-red crescent which extends anteriorly as an orange line onto middle of last spine; posteriorly the crescent is more red and bordered by dusky black lines. Pelvic fins yellow-orange. Pectoral fins hyalin, a faint orange line across base.

Stations: 7(1), 28(1), 61(4).

Habitat: A moderately rare species of rather confusing distribution in the lagoon. In some areas it is moderately common, and yet on neighboring coral heads and shore reefs it is absent. It normally occurs in small schools; very seldom just individually.

Pomacanthus imperator (Bloch).--Life colors of specimen from station 45: Ground color solid black. Lines yellowish-white. Entire dorsal and soft anal and outer one-half of caudal fin hyalin. Black on caudal fin bordered posteriorly by vertical yellowish-white line. Life colors of specimen from station 60 (adult 200 mm. in standard length): Head and body black to brownish-black. Head dark brown, lips darker. Broad black band the width of eye crosses interorbital. This black band bordered by dusky blue line. Posterior edge of operculum and anterior region of body with a broad vertical band that extends ventrally onto breast and belly; anteriorly this band is bordered by dark blue stripe. Body with approximately 17 horizontal orange lines that extend obliquely upward; 11 extending into dorsal fin. Dorsal fin white at edge. Spinous dorsal same color as body basally, with orange lines extending on posterior spines and continuing on soft rays. Soft dorsal posteriorly with orange filament at angle; last rays before angle narrowly edged in white, ventrally in black. Posterior to filament the black band is broader, and narrowly bordered by orange. Caudal fin orange; caudal peduncle gently fading from stripes into orange of caudal. Anal fin solid black, basally with narrow brown lines curving the same direction as those on body. Pelvic fins anteriorly narrowly edged in black; soft rays orange, shading to black posteriorly; membrane between first two soft rays orange. Pectoral fins with black rays and hyalin membranes.

Stations: 45(1), 60(1), 65(1).

Habitat: Entirely confined to outer reef flat and channels of atoll, although the natives said the adults also occurred around the lagoon coral heads.

Centropyge flavissimus (Cuvier).--Distinctive colors a solid yellow-orange overall with the eye ringed in blue. Life colors of specimens from station 61: Head with dusky grey on lower jaw. Blue line around eye broadest above and below. Blue line on bony opercular edge extending from edge of gill opening above to near where opercular spine crosses below. Spine yellow, with black tip. Last six dorsal spines and all of soft rays narrowly edged in hyalin with a submarginal black line. Posterior edge of caudal fin hyalin and with black line exactly as in soft dorsal. Anal fin same as soft dorsal; spines edged with hyalin and black line. Pelvic and pectoral fins the same color as body -- yellow-orange.

Stations: 23(1), 26(2), 61(16), 65(3), 66(1).

Habitat: Scattered individuals wherever there is active coral growth at a depth of 3-15'. This species prefers the lagoon coral heads, usually being found on the west face. At no locality was this species abundant.

FAMILY POMACENTRIDAE

Damsel Fishes

Seventeen species are recorded from Raroia, and I doubt that other species occur there. All species observed were collected. The Pomacentridae form one of the most important groups inhabiting the coral reefs at Raroia. Most of the species are restricted in habitat. Dascyllus aruanus occurs the deepest to a depth of 80' on the coralliferous outer bench. Abudefduf phoenixensis and Abudefduf sp. one are confined to the surge channels. Abudefduf imparipennis is the dominant fish on the sea urchin zone behind the coralline ridge and in the shallowest inter-islet channels. Pomacentrus nigricans dominates the tops of the reefs in the lagoon. Amphiprion bicinctus and Dascyllus trimaculatus live among the tentacles of large sea anemones in Garue Pass.

The natives have names for some of the species, but most of the pomacentrids have no names. MAMO is a general name referred to some species, but the natives are not sure for just how many damsel fishes this term is correct. Probably the name originally referred to all pomacentrids and is being lost, since the natives pay little attention to this group, and do not eat any of them.

Amphiprion bicinctus Rüppell.--Characterized by two vertical blue bands on side of head and body. No white markings on head. Head and breast orange. Life colors of specimens from station 66: Head, breast and

lower half of body anterior to anus bright orange. Vertical light blue band on head and body bordered by a black line. Iris orange, with a dusky blue crescent around posterior margin. Body shading to brighter orange on caudal peduncle and to solid orange on anterior lower part of body. Remainder of body orangish-brown. Spinous dorsal fin orange-brown, edged in black. Soft dorsal similar but without the black edge; longest rays dusky black at tip. Caudal fin orange, tips of rays dusky black. Anal fin like spinous dorsal, orange-brown with a black edge. Anus and surrounding area dusky black. Pelvic fins orange, the anterior and outer rays black. Pectoral fins orange, the outer region pale black.

Stations: 66(4).

Habitat: This species lives only among the tentacles of large sea anemones, which occur at Raroia only in a small patch in Garue Pass. These sea anemones are at a depth of 25', among abundant free-growing algae. Abudefduf lives in association with Dascyllus trimaculatus.

Raroian name: none.

Chromis caeruleus (Cuvier).--Life colors of specimens from station 61: General color solid dark blue shading to light blue below. In water the overall coloration is often an iridescent green or blue over head and body. Top of snout and interorbital pale black. Iris blue, narrowly gold around lens. Black band present at upper origin of pectoral fin. Dorsal fin pale black, with a black edge to spinous rays. Caudal fin bluish-black on scaled portion; outer rays black shading to pale black on middle rays. Anal fin dusky black. Pelvic fins with scattered melanophores on rays, membranes hyalin. Pectoral fins same as pelvics, but most of the pigment is on the upper first ray.

Stations: 9(9), 13(2), 37(1), 57(1), 61(60).

Habitat: This species prefers the calmer areas of the lagoon and the greatest numbers occur on the eastern coral heads. While it lives from the surface down to a depth of approximately 35' it prefers to remain around the upper edges of coral heads. It often is in association with Dascyllus aruanus.

Raroian name: MAMO.

Abudefduf septemfasciatus (Cuvier).--No spot present behind dorsal fin. Six black vertical bars on body. Preorbitals and preopercular edge naked.

Stations: 11(2), 45(1), 58(3).

Habitat: Uncommon at Raroia. Small schools observed along shore in lagoon and scattered individuals on outer reef flat.

Raroian name: KOTIMU.

Abudefduf sordidus (Forskål).--Black spot present at pectoral base. Another larger black spot present on upper half of caudal peduncle. Head and body with brown vertical stripes.

Stations: 8(3), 10(2), 11(2), 16(1), 17(1), 20(1), 22(3), 26(3), 35(2), 45(4).

Habitat: Scattered individuals along shore, but primarily lives in inter-islet channels and on outer reef flat.

Raroian name: KOTIMU.

Abudefduf sexfasciatus (Lacépède).--Life colors of adults from station 60: Head dark blue above, blackish in mid-dorsal region. Upper lip blue. Lower lip dusky blue. Head light blue below. Iris gold, ringed with black. No bands on head, except first body band borders operculum. Body anteriorly dark blue above and light blue below. Five vertical black bands present that do not extend onto belly. Spinous dorsal black; soft dorsal black anteriorly, blue posteriorly; upper edge of fin dusky black out onto filament. Caudal fin with middle of each lobe solid black; middle of fin bluish-black. Anal fin edged black, basally blue. Pelvic and pectoral fin rays dusky black, membranes hyalin.

Stations: 12(1), 22(11), 37(2), 38(5), 60(7), 61(1).

Habitat: Scattered individuals throughout lagoon around coral but abundant only in eastern and northern inter-islet channels and coral heads. Also lives in slightly brackish enclosed ponds on northeastern islets. Often occurring in association with Pomacentrus pavo.

Raroian name: TUKUPAHI.

Abudefduf phoenixensis Schultz.--Head and body brown. Vertical stripes on head and body yellow to orangish-yellow. Black spot present on pectoral fin base. Last body stripe followed by a vertical black bar, darkest dorsally. Entire caudal fin light yellow, almost completely white behind black bar. Anal fin blackish-brown, yellow-brown below black bar. Soft dorsal posteriorly edged orange-brown below black spot. Eye light blue. Yellowish-brown spots on cheeks and suborbitals. Raroia specimens differ from Schultz's types in having a black bar on pectoral fin base.

Stations: 17(6), 27(1), 58(12).

Habitat: This is the only pomacentrid besides Abudefduf sp. one found in surge channels and is entirely confined to this region. It is moderately common in the surge channels, and apparently lives in holes in the coral buttresses and under rocks.

Raroian name: TUKUPAHI.

Abudefduf imparipennis (Vaillant and Sauvage).--Keys out to A. imparipennis but differs somewhat in coloration. Upper part of head, body and most of caudal peduncle greenish-yellow. Lower half of head and body bluish-white. Ventral and posterior scale rows with an indistinct pale blue center, that tends to form faint blue longitudinal lines, particularly on the caudal peduncle. Spinous dorsal same color as back. Soft dorsal light yellow to hyalin distally. Caudal fin yellow to hyalin posteriorly. Anal fin slightly yellow. Pectoral and pelvic fins hyalin.

Stations: 11(1), 17(36), 22(9), 58(5).

Habitat: This species is rare in the lagoon, but one of the dominant species in the outer reef entrances to shallow inter-islet channels and is the dominant fish in the sea urchin zone behind the coralline ridge. It is quite rare on the remainder of the reef flat and absent from the surge channels. It lives in sea urchin holes and under rocks and coral.

Raroian name: MAMO.

Abudefduf dickii (Liénard).--Characterized by a vertical black bar on posterior part of body extending onto dorsal and anal fins. Life colors of specimens from station 57: Head uniform brown without markings. Darker brown on top of head. Eye narrowly rimmed in black. Iris light blue, darker blue above and below. Body crossed by a broad black band that shades out abruptly on dorsal and anal fins. Anterior to this vertical bar the body is solid brown; each scale with a blackish vertical line at posterior tip, forming vertical lines of black. Region below pectoral fin and belly solid brown without vertical black bars. Dorsal fin same color as body where covered with scales. Spinous dorsal dusky black, with pale centers on the membranes. Soft dorsal also dusky black with longest rays solid black; posterior rays hyalin at tip. Caudal peduncle rosy-white shading to a peach color on caudal fin. Anal fin with spines and membranes black. Pelvic fins brown, first spine and soft ray black. Pectoral fins orange.

Stations: 57(3), 58(1), 61(1), 65(1), 66(1).

Habitat: Uncommon at Raroia and very restricted in distribution to definite scattered localities. It lives in holes in coral heads and is rarely found on the outside.

Raroian name: none.

Abudefduf glaucus (Cuvier).--Body light blue with darker vertical fins. Anus black. Young with a brilliant blue line from tip of snout past upper edge of eye. Caudal lobes rounded.

Stations: 7(4), 8(130), 9(6), 10(73), 11(11), 12(1), 20(5), 22(66), 37(3), 38(14), 57(2).

Habitat: Probably the most abundant pomacentrid at Raroia, occuring almost entirely along the shore on the outer reef flats, inter-islet channels and shore reefs. It is the dominant fish in the shallow inter-islet channels continuous between lagoon and outer reef flat.

Raroian name: MAMO.

Abudefduf sp. one.--Caudal fin emarginate and outer rays dark. Black spot present on upper pectoral fin base. Life colors of specimens from station 59: General color silvery blue on top of head and back abruptly dark blue. Lower half of head and body light silvery blue. No markings on body or head. Upper edge of eye black. Iris iridescent silver, appearing light blue or green in life. Dorsal fin narrowly edged in white, submarginally bordered by a narrow black line. Spinous dorsal dark blue, soft dorsal also dark blue, except for basal portion of last soft rays which are hyalin. Caudal fins with outer rays bluish-black, inner rays pale blue to hyalin distally. Anal fin with entire edge blue. Pelvic fins white. Pectoral fins hyalin, a black spot at upper base.

Stations: 59(3).

Habitat: Apparently definitely restricted to deep surge channels with gravel or cobblestone bottoms.

Raroian name: None.

Abudefduf sp. two.--Keys out to Abudefduf filamentosus in Schultz (1943) but coloration entirely different. Anus pale white. Caudal fin lobes produced. Anterior part of body brownish-black; posteriorly abruptly white. Life colors of specimens from station 66: In life almost solid black posteriorly to a vertical from anterior soft dorsal rays. Posteriorly rays and body bluish-white shading to white. Outer portion of caudal fin dusky black and upper edge of dorsal and lower edge of anal black. Pelvic fins black. Pectoral fins hyalin with solid black base.

Stations: 66(4).

Habitat: Scattered individuals observed only on the shore reefs in Garue Pass in the vicinity of large sea anemones, but not living among the tentacles.

Raroian name: none.

Dascyllus aruanus (Linnaeus).--Characterized by black and white or black and light blue vertical stripes.

Stations: 7(16), 9(19), 13(1), 22(9), 37(1), 42(9), 61(21).

Habitat: The most abundant pomacentrid in the lagoon around all coral growth. Uncommon in inter-islet channels and rare on outer reef

flat. It was observed to depths of approximately 80' on the coralliferous outer bench. It especially prefers staghorn coral and pieces could be lifted out of the water without Dascyllus aruanus leaving them.

Raroian name: TUKUPAHI.

Dascyllus trimaculatus (Rüppell).--Solid black. Adults with a white spot on lateral-line under spinous dorsal, which is lost in preservative. Life colors of specimens from station 66: Head black above to dusky black below. No markings. Iris blue. Body black, each scale dusky blue at base and black at outer margin. A white spot of varying size on lateral-line and adjacent scales under last spinous dorsal rays. Most young lack this spot. Spinous dorsal solid black at edge shading to dusky black at squamation. Each membrane above scaled portion has a dusky green suffuse spot. Soft dorsal black at base shading to dusky hyalin distally. Caudal fin jet black. Anal fin jet black in region not scaled. Pelvic fins black with whitish base. Pectoral fins black.

Stations: 66(31).

Habitat: Seen only in Garue Pass, hovering over the same large sea anemones as are used by Amphiprion. They will also dive into the neighboring holes, but most dive into the sea anemone tentacles to escape danger.

Raroian name: none.

Dascyllus sp. one.--Solid dusky black with a vertical solid black band through pectoral fin. Posterior edges of caudal and soft dorsal fins yellow. No white spot on body. Life colors of specimens from station 23 one month after preservation: Body dark brown with dusky blue base to each scale. A suffuse vertical black band extends to pectoral fin base dorsally to nape and ventrally to pelvic fin base. Spinous dorsal solid black. Soft dorsal basally black, remainder of fin hyalin to pale yellow. Caudal fin basally dusky brown; most of fin pale yellow. Anal fin black, last ray dusky black at base and hyalin at tip. Pelvic fin jet black. Pectoral fins brownish-black at base, pale yellow to hyalin distally. No trace of white spot on body but I have a recollection that there might have been one in life, though the field notes do not discuss this coloration. Largest specimens without trace of vertical black band.

Stations: 23(2).

Habitat: Taken on shore reefs in lagoon near Garumaoa Village but otherwise not observed in field.

Raroian name: none.

Pomacentrus pavo (Bloch).--Body and head blue with brilliant metallic blue spots. Black spot on upper opercular border. Life colors of specimens

from station 37: Head and body solid blue. Head dorsally dusky black. Each scale on head and body with a brilliant metallic blue spot, these spots small and indistinct on top of head. Large scale of upper border of operculum solid black with a light edge. Upper lip with a median blue streak and a lateral blue spot. Lower jaw covered with a horizontal streak. Body dark blue above (black in formalin) to lighter blue below, each scale with a brilliant metallic blue spot. Caudal peduncle blue anteriorly shading to yellow posteriorly. Spinous dorsal bluish-black, distally with three rows of longitudinal pale blue streaks on each membrane. Soft dorsal also bluish-black, with irregular continuations of pale streaks. Longest rays pale yellow distally. Caudal fin bright yellow shading to dusky blue at the base of each lobe. Anal fin blue-black, not as dark as dorsal fin, yellowish at tip. Paired fins hyalin.

Stations: 37(2), 38(3), 61(6).

Habitat: It is moderately abundant in the lagoon around coral in the calmest localities; this species is a typical inhabitant of coral heads close to shore on the east and north sides of the atoll, especially in protected bays and closed off inter-islet channels.

Raroian name: MAMO.

Pomacentrus albofasciatus Schlegel and Müller.--General color black or dark brown with a black spot at end of dorsal base preceded by a white spot.

Stations: 9(3), 65(2).

Habitat: Same distribution as Pomacentrus nigricans but considerably less abundant.

Raroian name: MAMO.

Pomacentrus nigricans (Lacépède).--Solid dark brown fading into yellow-brown on edges of dorsal and caudal fins. Black spots at upper pectoral base border and at end of dorsal fin base.

Stations: 7(25), 8(3), 9(87), 11(2), 12(18), 13(12), 22(1), 23(48), 28(95), 49(2), 57(3), 61(83), 65(12).

Habitat: Almost entirely confined to lagoon where it is very abundant on top of coral shelfs and coral heads. It is rare in depths below a few feet. It is also found in inter-islet channels and occasionally on the outer reef flat.

Raroian name: MAMO.

FAMILY LABRIDAE

Wrasses

Apparently the third largest fish family and certainly one of the most conspicuous groups at Raroia is the Labridae. Twenty-five species are recorded in field notes, although less than half the material collected was examined. Perhaps an additional 10 species will be added after further study. All species noted at Raroia except three were collected and extensive notes prepared of many species. According to the natives a few additional species (of "PAKOU") were missed. Wrasses are abundant at Raroia wherever there is coral, forming an especially important part of the lagoon fauna on coral heads and shore reefs. All the species are partial to definite habitats, although only part of this data is presented in the following notes; the remainder of the notes will have to be checked with the unrecorded collections.

Of particular interest is the large number of species (9) of the genus Thalassoma occurring at Raroia. In fact this is the dominant labrid genus at this atoll and occurs in great numbers in the lagoon. The next largest genera in number of individuals at Raroia are Pseudocheilinus, Halichoeres and Stethojulis.

The natives refer to most wrasses as PAKOU and have specific names for only a few species. The natives commonly use most of the larger wrasses for food, preferring most of all the genus Cheilinus.

Epibulus insidiator (Pallas).--Characterized by a protractile mouth. Life colors: Solid black to solid yellow and all stages in between.

Stations: 7(1), 23(5), 28(3), 49(3), 61(1), 66(1).

Habitat: Scattered individuals around lagoon coral heads and shore reefs, although never particularly abundant at any locality.

Raroian name: TUPIROPIRO.

Labrichthys sp. one.--Head and body fully scaled with remarkably large scales. Life colors of specimen from station 57: Head and body olive brown. Head with light upper lip; reddish lower lip. Interorbital dusky black. Bordering posterior edge of eye is a broad yellow band edged with brown stripes meeting above on occiput and ending at opercular border below. Eyeball green. Iris light blue, narrowly edged with red around lens. Body uniform olive brown, except for vertical yellow band edged with brown stripes at origin of caudal peduncle; yellow continues anterior to black spots on anterior part of soft dorsal and anal fins. Spinous dorsal uniform olive brown. Soft dorsal with a black spot at anterior edge ringed narrowly with light blue and red lines. Rays behind spot red, membranes hyalin. Caudal fin white basally, reddish-brown medially and out each lobe. Tip of each lobe solid white. Anal fin with spot and rings similar

to dorsal. Rays behind red ring with hyalin membranes. Pelvic fins light blue at base and tip; middle with a broad brown band. On belly behind pelvic fin is a large round brown spot that matches the brown band on the pelvic fins. Pectoral fins red.

Stations: 57(1).

Habitat: Two specimens were taken at the base of lagoon coral heads at 6' and 25' depths. They appear to be the young of a presumably different colored adult.

Raroian name: none.

Stethojulis rhekadopleura (Bleeker).--Bright orange spot above pectoral fin base. Pale longitudinal series of spots on lower half of body. Suffuse red streak along body at level of pectoral base. Two black spots ringed in blue on caudal peduncle. A suffuse band extends horizontally across head beneath eye.

Stations: 9(6), 22(2), 23(1), 28(2), 49(1), 50(4).

Habitat: Uncommon; small schools occasionally observed in shallow water in inter-islet channels and around lagoon coral heads. Most specimens were noted in less than 10' depths. This species definitely prefers shallow sandy areas with dead coral and rubble.

Raroian name: PAKOU.

Stethojulis sp. one.--Characterized by 9 dorsal spines. Projecting canine in upper jaw at rectus. No canines at symphysis of lower jaw. Three red lines horizontally across side of head, two of which continue along midlateral region of body. Mid-caudal rays black. Colors of specimens from station 14 one month after preservation: General ground color yellow-green, brownish on back. Head with 3 longitudinal red bands. Upper bands start on snout at level from top of eye, continuous across top of snout. These bands extend posteriorly from middle of eye to above pectoral fin base. A faint orange line extends obliquely backwards from eye, fading out on nape; not continuing across top of head. Mid-lateral band on head starting from posterior edge of upper jaw, extending to lower border of eye, then across operculum to above pectoral fin and fading out over middle anal rays. Lower mid-lateral band continuous across throat, but not reaching opercular border. This line continues on body bordering operculum to near pectoral fin base; then there is a spot at pectoral base and the line continues on the body below the mid-lateral line. Head with a broad suffuse black spot between eye and upper opercular border. Iris dark blue. Fins pale yellow. Caudal fin with a black streak on basal half of middle rays. Life colors of specimens from station 28: Same as previously described except for effects of preservation. Mid-lateral bands pink. A large yellow saddle edged in black present over pectoral fin base. Iris gold. Lower half of side with five series of brownish spots near

the center of each scale. Preopercle and chin pale blue. Outline of back edged with a blue line.

Stations: 14(2), 28(5).

Habitat: Recorded from inter-islet channels and lagoon coral heads.

Raroian name: PAKOU.

Leptojulis sp. one.--Canine present at corner of upper jaw. Large black spot on first soft dorsal rays. Life colors of specimens from station 57: General ground color dark blue to bluish-black. Head with numerous pale lines, largest below eye. Lines on top of head faint, ending on snout. Iris blue-black with a paler longitudinal streak below lens and a pale line from the upper posterior margin of the eye. Lips pale. The pale coloration mentioned previously in this description is a slate grey mixed with blue; all pale markings on the body are this color. Body with many closely spaced pale longitudinal lines on the middle of scale rows, extending out to caudal base. Dorsal and anal fins intricately marked. Spinous dorsal with 3 longitudinal pale wavy lines. Soft dorsal anteriorly with a solid black oval spot narrowly edged with a pure white and a narrow bluish-black line. Remainder of soft fin with a large irregular longitudinal streak down the middle of the fin. Tips of soft rays hyalin. Caudal fin uniform pale black. Anal fin exactly the same as soft dorsal except lacking spot and rings. Pelvic fins pale black. Pectoral fins yellow-green basally shading to hyalin on outer half of fin.

Stations: 57(2).

Habitat: Recorded from lagoon reefs north of Garue Pass. Rare at Raroia.

Raroian name: PAKOU.

Thalassoma marnae Schultz.--Characterized by a suffuse broad longitudinal line on head and body; emarginate caudal; black pectoral base. Previously known only from young type. Life colors of specimens from station 61: General color above pale greenish-olive drab, white below. Head dusky olive drab above, a suffuse broad black band extending from snout through eye to operculum. Lower edge of line at lower margin of eye. Region below line abruptly dusky white. Iris greenish-silver. Lips dusky green, blackish medially. Body with upper half blackish to olive drab, abruptly white below. A suffuse broad median lateral blackish band continues from head posteriorly and fades out on caudal peduncle. Medially on side the black is composed of suffuse vertical stripes, usually two to a scale. Pectoral fin base with a black spot above. Spinous dorsal fin black. Soft dorsal dusky black with a hyalin edge. Caudal fin pale black on tips of lobes. Anal and pelvic fins hyalin. Pectoral fin pale yellow at base, hyalin on outer half.

Stations: 61(3).

Habitat: Observed only on large eastern lagoon coral heads among dead coral rubble.

Raroian name: PAKOU.

Thalassoma quinkuevittata (Lay and Bennett).--Characterized by black spots along dorsal base. Black spots in membranes of first spinous and first soft rays. Life colors of specimens from station 57: General color green with white below. Head with black spot on snout above symphysis of upper jaw. Occiput orangish-brown. A blue band extends from upper posterior edge of eye across operculum; blue edged with blackish line. Another band extends from lower edge of eye to upper edge of pectoral fin. Two red streaks present on upper part of operculum. Head shades to white below. Iris green, edged in gold around lens. Body with 2 oblique red stripes under pectoral fin. Three longitudinal orangish-red stripes extend mid-laterally along body, the upper two connected by numerous oblique orangish-red lines. Dorsal fin hyalin with suffuse green on basal half; first two spines and first membrane with a large black spot. Fourth from last spine with a black spot at base; last four membranes with short red lines continuing obliquely forward. Another large black spot between second and third soft rays. Fourth from last soft rays with a black basal spot; fourth to sixth soft rays with red lines continuing forward into fin. Caudal fin hyalin except middle ray green at base and yellow-orange in the middle of the fin, hyalin at the tips. Anal, pelvic and pectoral fins hyalin.

Stations: 57(2), 58(25).

Habitat: Recorded from both lagoon and outer reefs.

Raroian name: PAKOU.

Thalassoma schwanenfeldii (Bleeker).--Anal fin without black spot. Dorsal fin with 3 black spots. Body with 6 wide vertical black bands. Life colors of specimens from station 45: General color greenish, some specimens shading to pale blue below. Head blackish above, 2 large orange spots below eye. A black or bluish-black or solid blue line posteriorly from eye to opercle border. Iris green, narrowly gold next to lens. Underside of head pale blue to white. Body bright green to dusky green above. Six vertical black saddles on back; the first extends down to a horizontal from pectoral fin, the others do not. No longitudinal pale bands on body. First 3 black bands usually continued below with suffuse yellow-green coloration. Belly and breast pale blue to white. Last band on top of caudal peduncle very small in some specimens. Dorsal fin pale green to hyalin, with 2 or 3 spots near base; first spot on first spinous membrane, second between 2nd and 3rd soft rays, last over 5th black band, and is continuous with

the band on the body. Caudal fin pale yellowish-green, outer rays may be pale orange. Anal fin pale green to hyalin. Pelvic fin hyalin. Pectoral fins pale yellow, base more intense yellow.

Stations: 7(16), 9(12), 13(1), 23(3), 28(9), 38(1), 45(2), 49(1), 50(1), 61(11).

Habitat: This species is one of the most abundant wrasses at Raroia in the lagoon on shore reefs and coral heads. It is particularly abundant on the west side of the atoll in the lagoon wherever there is coral. It also was found in the enclosed brackish ponds on the northeast islets.

Raroian name: PAKOU.

Thalassoma hardwicke (Bennett).--Characterized by 6 vertical black bands and a black spot in the anal fin. Life colors of specimen from station 61: Head and body yellow-green above and blue below. Head with 5 broad orange bands radiating from the eye, the uppermost meeting across the interorbital. Lower jaw and lower part of preoperculum blue. Upper half of head yellow-green, dark on top of head. Two large orange spots on nape, the uppermost continuous across top of head. Iris red around lens, outer half green. Body with 6 black vertical bands on side of body, the last a spot near top of caudal peduncle. Next to opercular flap on body is an irregular black spot that is not continuous across back. Other black bands are continuous over top of body. First black band long, extending below a vertical from pectoral fin. Remaining bands not extending below mid-lateral line. Along mid-lateral region from second band to middle caudal rays is a pink stripe. Pectoral base black. Dorsal fin with a median black longitudinal band that extends unbroken to above fourth band and ends at fifth band. Remainder of fin dusky hyalin. Caudal fin dusky yellow on base and outer lobes, median rays dusky black. Anal fin anteriorly with a black spot at middle of second ray. Middle of fin pale dusky yellow. Pelvic fins hyalin. Pectoral fins hyalin except for dusky black outer half and brownish-black upper edge.

Stations: 23(6), 61(1).

Habitat: Rare at Raroia. Field notes record small schools in the lagoon on scattered shore reefs and coral heads.

Raroian name: PAKOU.

Thalassoma umbrostigma (Rüppell).--Black spots on head. Short vertical black lines on scales. Green longitudinal band on middle of soft dorsal and soft anal fins.

Stations: 10(16), 11(3), 14(5), 17(1), 20(1), 22(10), 23(1), 26(13), 27(2), 45(5), 58(1), 65(5).

Habitat: Abundant wherever there is coral growth around the atoll. Adults are speared for food by the natives on the outer reef flat and coralline ridge.

Raroian name: PAKOU.

Thalassoma trilobata (Lacépède).--Double red line extends down side of body. Vertical narrow green blotches present between vertical red lines.

Stations: 9(2), 22(4), 23(1), 26(2), 27(1), 28(2), 33(1), 58(10), 61(6), 65(1).

Habitat: Same as Thalassoma umbrostigma although not as abundant, and tends to inhabit deeper water.

Raroian name: PAKOU.

Thalassoma purpureum (Forskål).--Two longitudinal stripes along bases of anal and dorsal fins.

Stations: 7(2), 17(14), 45(6), 58(2), 60(1), 65(4).

Habitat: This species occurs throughout the reefs but is most abundant on the outer reef flat and surge channels. It is a deeper water species, coming into the shallow areas to feed at high tide.

Raroian name: PAKOU.

Thalassoma sp. one.--Differs from all described in the literature available by having head pattern of purpureum; three longitudinal stripes on body without cross lines. Life colors of specimens from station 52: General color bright green above and bright blue below. Head with broad solid orange stripes on snout, occiput, nape and operculum. Iris green with a reddish gold ring around lens. Eyeball orange below, green above. Edge of opercular flap orange. Body with 3 longitudinal orange stripes, the uppermost brownish-orange, all stripes extending onto caudal fin. An oblique orange stripe present below pectoral fin and 2 orange spots on pectoral base. This region around pectoral base green. Entire underside of head and belly bright blue. Dorsal and anal fins basally with a longitudinal orange stripe. Edge of fins blue-green. Caudal fin blue-green with an orange longitudinal stripe inside of outer prolonged rays in each lobe. Median rays edged in faint orange. Pelvic fins solid blue. Pectoral fins blue, dusky black on first 2 rays.

Stations: 52(2).

Habitat: Recorded from outer reef surge channels north of Garue Pass.

Raroian name: PAKOU.

Thalassoma sp. two.--General color yellowish-orange to orangish-green. Head with two longitudinal orange-red lines. Dorsal fin with a black spot and blue line along its length. Colors of specimens from station 23 one month after preservation: Head dusky above to yellow green below. Lips yellow-green, dusky at tip. Iris black posteriorly, golden anteriorly. Below eye a longitudinal orange-red line extends from behind rictus to preopercle border. Orange spot present on operculum slightly above a horizontal from eye. Another orange line present below eye on a horizontal from lower lip. Two reddish-orange spots behind eye. Body dusky brownish-yellow green above to paler yellow-green below. Breast and belly reddish. Side of body with two vertical dusky blue lines on each scale that form vertical lines on side of body as in umbrostigma. Base of pectoral fin with a black spot. Dorsal fin with a black spot on first two membranes - continued the length of the fin by a pale longitudinal blue band that is edged by a darker blue line. Remainder of spinous dorsal bright yellow to yellow-green. Soft dorsal otherwise hyalin with a bright yellow edge. Caudal fin pale yellow-green with a bright yellow posterior edge on median rays. Anal fin basally with a narrow longitudinal red band bordered distally by a bright blue line. Remainder of fin bright yellow tinged with green. Pelvic fins hyalin tinged with yellow. Pectoral fin basally bright yellow shading out to hyalin. Head of larger specimen at station 23: two dark blue bands extend posteriorly from eye. Two broad orange-red bands extend longitudinally below eye. Snout with an orange band between eye and posterior half of upper lip. Lower side of head bright yellow-green.

Stations: 23(2)

Habitat: Recorded from western shore reefs in lagoon. Rare at Raroia.

Raroian name: PAKOU.

Halichoeres trimaculatus (Quoy and Gaimard).--Black spot on caudal peduncle. Blue and orange spots on head. Canine at rictus of mouth in upper jaw. Black spot on pectoral axis. General color green with orange-red fins.

Stations: 8(18), 9(22), 10(1), 11(4), 12(1), 14(7), 23(4), 28(9), 37(1), 38(7), 42(1), 49(1), 50(6), 65(5).

Habitat: Abundant in shallow water wherever there is coral; most prominent in the lagoon on shore reefs and coral heads.

Raroian name: PAKOU.

Pseudocheilinus hexataenia (Bleeker).--Characterized by red and green longitudinal stripes and by pointed snout.

Stations: 7(7), 9(1), 57(1).

Habitat: One of the most abundant, yet least conspicuous, wrasses at Raroia. Particularly common in lagoon in 5-30' depths at the base of coral and sides of coral heads.

Raroian name: MAMO.

Gomphosus tricolor Quoy and Gaimard.--Characterized by solid indigo blue fins. Colors of specimen from station 23 one month after preservation: Overall color indigo blue; each body scale with a reddish-brown vertical band basally. Head mottled green around eye. Iris narrowly gold around lens, green for remainder. Dorsal and anal fins blue-green, considerably lighter than body. Caudal fin blue-green, the upper and lower edges very dark blue-green. Pelvic fins pale blue-green, first spine and soft ray black. Pectoral fin black at upper base, middle of fin crossed by a vertical black band. Outer half of fin blackish blue-green, basal half brighter blue-green.

Stations: 23(1).

Habitat: Rare at Raroia, only a few individuals observed on lagoon coral heads and shore reefs.

Raroian name: KUTU (small), PAPARARI (large).

Gomphosus varius Lacépède.--Characterized by a black dorsal fin with white margin, and black anal fin with white spot on each ray. Dark spots on body.

Stations: 7(2), 9(1), 13(3), 23(1), 28(3), 42(1), 57(2), 61(2).

Habitat: Common in lagoon around shore reefs and coral heads. Often observed in association with Labroides.

Raroian name: KUTU (small), PAPARARI (large).

Cheilinus undulatus Rüppell.--Characterized by black stripes extending from eye obliquely forward and posteriorly. Life colors of specimen from station 52: General color olive brown. Head uniform brown shading into blackish-brown on occiput and nape. Most of head except above eye with reticulate pattern of narrow orange lines extending over lips, opercles, snout, and all of gill membranes; these reticulations shade into red on operculum proper. Lips and anterior lower half of head shading to green. Body blackish brown in a broad band along back. On side of body each scale with a broad vertical olive brown line; these tend to become larger on dorsal and posterior scales. Scales in pectoral fin region, breast and belly, with fine reticulated red lines. Vertical fins with narrow vertical brownish-black stripes. Interspaces green. Edge of caudal fin yellow-orange. Pelvic fins light green, with red reticulations on bases of first two rays. Pectoral fins with basal two-thirds of fin with fine red reticulations; posterior third of fin light brown to hyalin.

Stations: 33(1), 52(1).

Habitat: Common in Garue Pass and in deeper water beyond surge channels around outside of atoll; occasionally coming into surge channels to feed.

Raroian name: MARAIA (extremely large), TATIKA (very large), TAPIRO (large to small).

Cheilinus trilobatus Lacépède.--Young characterized by pale blue stripe edged in black; general color brown; snout prolonged. Nine dorsal spines present. Life colors of adults from station 49: Ground color green to brownish-green. Head bright green with red wavy streaks, a few radiating from eye anteriorly. Suffuse darker areas at opercular margin, jaws, interorbital and nape. Body darker than head, with four distinct broad vertical brown bands which extend onto the dorsal and anal fins. Each scale has a reddish vertical streak across its base and onto the tip of the preceding scale and the anterior portion of the upper and lower scale, forming oblique red streaks. Dorsal fin with dark brown vertical bands through the first, fourth to fifth, and seventh to ninth spines; ground color of spinous dorsal green; there are also two longitudinal wavy orange lines that extend onto the first soft rays. Soft dorsal green basally, pale orangish-red over middle of fin and hyalin distally. Caudal fin marked like body at base; medially there is a broad greenish-brown blotch bordered posteriorly by a narrow irregular green streak; this streak is bordered by an irregular red line; edge of caudal fin pale green. Anal fin similar to spinous dorsal; two reddish-brown wavy streaks near edge of fin; anteriorly spines and rays narrowly edged pale green; posteriorly fin green basally, mottled reddish-brown and green across middle, shading to pale red and hyalin distally. Pelvic fins green on the rays and bright red on the membranes. Pectoral fin pale orange, light green at base of rays.

Stations: 7(1), 23(2), 49(4).

Habitat: Lives in the ulva-like Microdictyon algae on coral heads and shore reefs, particularly at the southwestern protected side of the island. In fairly shallow water, seldom free swimming, usually hiding in algae.

Raroian name: TUPIROPIRO.

Cheilinus chlorourus (Bloch).--Characterized by 10 dorsal spines and by black spots on body anteriorly. Life colors of specimens from station 49: Ground color green to brownish-green. Head mottled green to brownish-green, covered by red streaks and spots which extend onto lips; also numerous blue spots on postorbital region. Body with four suffuse vertical bands which are greenish-brown, same pattern as in trilobatus, except lighter. Many anterior scales have black spots; red spots on

occiput. Each scale with a blue spot at base--no vertical red lines at base of scales; blue spots are not obscured by a vertical band, most distinct on caudal peduncle. Dorsal fin mottled green and greenish-brown; also with suffuse scattered black spots. Tips of spines pale, tips of membranes pale red. Soft dorsal anteriorly same color as body and first dorsal with blue spots and black spots and mottled green coloration; posterior rays green at base; medially suffuse pale red with pale blue spots, hyalin distally. Caudal fin light green at base, irregularly reticulated vertically with suffuse red, green and brown lines. Anal fin same as dorsal; membrane between first two spines black. General color mottled green with blue spots overall. Pelvic fins with green rays and pale brownish-red membranes. Pectoral fins hyalin, rays pale orange.

Stations: 13(1), 23(3), 42(2), 49(3).

Habitat: Same as Cheilinus trilobatus.

Raroian name: TUPIROPIRO.

Labroides dimidiatus (Valenciennes).--Life colors of specimens from station 61: Head blue with a median black line on top of head from tip of upper jaw posteriorly to dorsal fin. Side of head with a solid black stripe through sides of lips and eye, becoming larger posteriorly across operculum. Iris gold with a blue-green circle in middle. Body with the median black stripe on back becoming suffuse posteriorly and abruptly smaller near end of spinous dorsal, ending on body shortly thereafter. Black band on middle of side becomes larger posteriorly, always with a precise outline, extending to end of tail. Area between these two black bands is solid blue. Region below mid-lateral band on body light blue, becoming darker bright blue next to anal fin. Middle of side red shading ventrally to pale red. Belly pale red. Red areas tend to have narrow red longitudinal streaks on each scale row. Dorsal fin solid black anteriorly, narrowing posteriorly into a median longitudinal black line that extends the length of the soft dorsal. Basal portion of the soft dorsal intense dark blue; edge pale blue. Caudal fin black in middle, intense dark blue above and below. Anal fin anteriorly solid dark blue shading to pale blue distally; posterior rays with a median longitudinal black band. Pelvic fins hyalin. Pectoral fins hyalin except rays edged in black.

Stations: 13(1), 28(1), 61(5).

Habitat: Common in lagoon in coral on shore reefs and holes on coral heads. Rarely observed on outer reef. This genus is very shy and extremely difficult to obtain. Three species of Labroides were noted at Raroia but only a few specimens of one species were taken.

Raroian name: none.

Coris angulata Lacépède.--Colors three weeks after preservation of specimens from station 45: In life most conspicuous marking is a pure white

vertical band on body. In formalin head dusky pale green above to white below. Spots on head pure black, tending to be ringed by a pale blue line on occiput and nape. Iris dusky gold, with three spots near outer margin. Body anteriorly pale dusky white with a pale yellow shading. White band extends to mid-ventral region. Posterior half of body black above shading ventrally and posteriorly into dusky pale brown, somewhat yellow tinged with green. Dorsal fin anteriorly (before posterior margin of vertical white band) dusky black with white edge; numerous black spots basally. Remainder of dorsal solid black with white edge. Caudal fin edged in pure white. White bordered by solid black that shades anteriorly into black spots. Anal fin edged white, bordered by solid black that shades basally to dusky black. Black area of fin covered by numerous intense black spots. Pelvic fins with anterior rays dusky black shading to hyalin. Pectoral fins with a black spot on middle of base; fin pale blue, upper edge tinged with orange.

Stations: 45(2).

Habitat: Rare at Raroia. Individuals noted on outer reef flat at high tide hiding in holes. Two were observed on lagoon coral heads among thick ulva-like algae.

Raroian name: MARARI.

Novaculichthys taeniourus (Lacépède).--Life colors of specimen from station 49: General color yellowish-brown. Ground color of head yellow-green to greenish-brown; lines radiating from eye brown, shading to a lighter greenish-brown, edged in light blue. Each scale on body (except those on belly) greenish-brown, with a basal light blue spot. Belly scales bright red, edged in white and then hyalin. Large scale behind opercular flap with a long solid black base. Scales posterior to lower pectoral rays forming a vertical solid black stripe. Dorsal fin same as body except membranes between first three spines with two large black spots. Remainder of fin with oblique rows of greenish-brown spots with hyalin interspaces, becoming more brown posteriorly; edge of soft dorsal hyalin. Caudal fin crossed by a broad white vertical band; edge of fin narrowly hyalin; remainder of fin greenish-brown with vertical irregular orangish-brown lines. Anal fin darker than body, with oblique rows of brown spots, and greenish-brown interspaces. The tip of each soft ray is hyalin. Distally the membranes tend to be blackish, particularly anteriorly. Pelvic fins with reddish-black rays, and solid black membranes; tips of last three soft rays white. Pectoral fin brownish-black basally, upper margin reddish, median region yellow, distally pale red and hyalin.

Stations: 47(1), 49(1).

Habitat: Rare at Raroia. A few individuals noted on large coral heads in southwest region of lagoon and one observed and collected on southern sand flats among coral rubble.

Raroian name: MARARI.

FAMILY SCARIDAE

Parrot Fishes

The dominant group in the open water around the coral heads and shore reefs is the family Scaridae. The natives eat more parrot fishes than any other group. None are poisonous. The Raroians have names for each species and know their habits and distribution well. They say that there are two main groups--the majority of the scarids grow large, over a foot in length, while others remain small, remaining about 6" in length.

Fourteen species were recorded in the field but at least six species were observed that were not taken and probably approximately twelve species occur at Raroia that were not collected. They occur in all marine habitats and great numbers come over the reef flats at high tide to feed.

Most of the larger species are speared with four-pronged barbed spears by the natives along the coralline ridge and inter-islet channels. According to the natives a few parrot fishes are taken by hook and line. Most of the species are wide ranging in habitat at Raroia, but a few are definitely restricted to certain coral heads and habitats in the lagoon.

Since the family Scaridae is poorly known in the tropical Pacific, the greatest amount of color notes and kodachrome photographs were taken of this group.

Scarus formosus (Valenciennes).--Characterized by a blue-green rectangle on tail. Life colors of specimen from station 52 immediately after capture: General color of head purplish red, greenish-yellow on nape. Two lines radiating from posterior border of eye: upper blue-green, lower green. Lines on lips extending to eye solid blue, bordered and shading into green. Second stripe below mandible medially blue and distally green. Longitudinal stripe on subopercle margin green. Edge of operculum blue-green immediately before pectoral fin. Dental plates white. Body yellow-green above shading to purplish-red below and to green on caudal peduncle. Above horizontal from lower border of pectoral fin each scale has a vertical green line basally and an orange line at tip; these lines form oblique steps. Posteriorly the green markings become large around spots and the orange stripes are faint. Body at anal base bright green, shading to blue posteriorly. Caudal peduncle covered with large green spots with suffuse orange in between. Dorsal fin edge solid blue ending at second to last ray; dorsal base blue-green edged ventrally by a yellow-green band shading into coloration on body. Area between the blue markings orange; membranes between first two spines purplish-orange. Last 1½ rays blue. Caudal fin edged in blue-green above and below. Medially a blue-green rectangle borders the edge of the fin. Remainder of fin reddish-orange, basally shading into caudal peduncle coloration. Anal fin same as dorsal except blue at edge also covers first spine. Pelvic fins blue except for a red streak extending from base to tip of

second and third soft rays. Pectoral fin rays blue-green, reddish at tips of longest rays.

Stations: 28(1), 52(1).

Habitat: Schools observed in lagoon around coral heads and along reefs.

Raroian name: TOKATI.

Scarus pulchellus (Rüppell).--Characterized by two broad blue-green stripes below lower jaw. No stripes between rictus and eye. Fine green spots over head and lower half of body. Life colors of specimens from station 52: General color green above shading into orange below. Ventrally head bright orange. Lips submarginally bordered by blue-green lines which do not meet at rictus. A short broad blue-green stripe extends behind lower jaw band. Gill membranes medially with a blue-green spot anteriorly and an elongate blue-green line posteriorly. Upper half of head covered by short green lines and spots in a reticulated pattern. Body dark green above shading into irregular green spots and stripes below. Anteriorly each body scale has several dull orange spots and stripes except breast scales which are solid orange. Caudal peduncle solid green except for a reticulated orange pattern ventrally. Dorsal fin dark greenish-orange for most of fin; edged in blue-green, basally dark green. Caudal fin narrowly edged in blue-green; longest upper and lower rays orange. Middle of fin blue-green with orange spots. Anal fin blue-green, with orange reticulations and spots basally extending out to end of fin on last rays. Pectoral fins greenish-black, lower rays with hyalin edge. Spines and first rays of pelvic fins blue. Remainder of fin orange with blue spots on membranes.

Stations: 34(1), 52(2), 54(2), 55(1), 58(2).

Habitat: Abundant along outer edges of surge channels, coming into surge channels and over reef flat to feed.

Raroian name: GNAVERE.

Scarus microrhinos (Bleeker).--Characterized by large gibbous forehead, by a suffuse line from rictus across side of head, and by the lack of markings before eye. Life colors of specimen from station 52: Upper half of head and body green to blackish-green, lower half yellow-green. Head with broad bright green stripe bordering lower jaw and extending posteriorly across head to opercular flap. This line expands posteriorly, becoming suffuse and dark dorsally. Upper lip narrowly edged with a green line that does not quite meet lower jaw streak. Eye surrounded narrowly by green that extends in broad suffuse band onto nape and posterior region of head. Iris gold. Eyeball metallic blue above, blue-green below. Teeth narrowly edged in white, remainder blue-green, more greenish towards tips. Gill membranes with a median

green streak that is interrupted once. Body dark green above shading into bright green near mid-lateral line. Lower half of body abruptly yellow-green. Caudal peduncle all green except for anterior lower portion which is colored like lower half of body. Dorsal fin edged blue-green; base of fin with a narrow irregular green line that extends slightly up on the membrane at the middle of each membrane. Caudal fin green, an orange line borders outer most long ray to tip of prolonged filaments. Irregular spots and lines vertically in middle third of fin. Middle rays blackish near tip. Anal fins similar to dorsal fin except anterior membranes green in center instead of orange, shading to greenish-orange posteriorly. Pelvic fins with spine blue; membranes of soft rays white in center, blue-green distally; soft rays blue-green. Pectoral fin dark; first ray blue; remainder of fin green to blue-green; upper tip shading to solid black; lower rays edged hyalin; yellow-green across base.

Stations: 19(1), 33(2), 47(1), 52(1).

Habitat: One of the most abundant parrot fishes at Raroia; common both inside and outside the lagoon in large schools.

Raroian names: KOPAHOPAHO (small), TEGATEGA (medium), TONAE (very large).

Scarus forsteri (Valenciennes).--Characterized by dark green teeth, by a broad stripe from behind jaws to opercular border. Life colors of specimens from station 33: General color of head green to bluish-black above. Two green stripes extending posteriorly from eye. Isthmus with a short median green line. Head ventrally brown to greenish posteriorly. Body bluish-green dorsally, green laterally, and brown ventrally. Each scale dark brown basally, forming oblique longitudinal streaks. Anal fin base blue-green on body. Caudal peduncle green. Dorsal fin edged with a bright blue stripe, basally with a narrow bright green stripe; last 8 soft rays with a median longitudinal green stripe; last 2 rays green. Caudal fin dark; edged in bluish-green dorsally, ventrally and posteriorly; medially with a wavy broad brown vertical line extending into each lobe. Anal fin same as dorsal; last 9 rays with a median longitudinal streak. Pelvic fins with first and last rays blue; middle of fin brown. Pectoral fins dark; first 3 rays blue-green; next 3 rays brown; remainder of fin blue-green, fading to hyalin at edge of fin.

Stations: 33(2), 45(2), 47(1), 54(1), 61(4).

Habitat: Abundant both inside and outside lagoon.

Raroian name: KOPUMERI (large to small), NOGA (very large).

Scarus sp. one.--Characterized by a black spot on caudal peduncle surrounded by a light area.

Stations: 7(6), 13(1), 23(12), 28(4), 42(3), 45(1), 49(2), 61(35), 65(6).

Habitat: Abundant both inside and outside lagoon.

Raroian name: PITIKA KONIHO.

Scarus sp. two.--General color pure whitish-yellow without any markings on head, body or fins. Teeth white. Lips cover teeth.

Stations: 45(9).

Habitat: Abundant at southwestern end of Raroia on coral heads and reef flats and in surge channels. It would move onto the outer reef flats in great numbers at low tide to feed.

Raroian name: KUKINA (small to large), HAUEKE (very large).

Scarus sp. three.--Lips not edged with dark coloration nor are there any dark markings on the head. Light orange spots and streaks on head. Life colors of specimen no. 2302 from station 33: Solid green overall. Head uniform green except mottled with lighter yellow-green markings on lower opercular region. Lips same color as remainder of head. A submarginal light orange wavy line present along lower jaw and is not continuous across chin. Numerous light orange spots and streaks behind mouth and around eye, some radiating from eye for a short distance. Iris gold. Eyeball green. Body solid dark green without spots or streaks as on head. Base of each scale on side of body with a pale orange vertical stripe, becoming spots on caudal peduncle. Breast and body solid green. Scales not dark along caudal base. Dorsal fin green, with a blue-green edge to the fin that extends to last rays. Last rays not darker than other rays. Base of dorsal fin with an irregular line that extends slightly up in each membrane. Blue-green spots and streaks over entire fin. Caudal fin dark blue-green shading to green on posterior margin. Middle of fin with a reticulated network of orange spots and streaks, one streak extending out to the tip of each lobe. Anal fin with a blue-green edge and irregular blue-green basal line similar to dorsal; two irregular longitudinal series of blue-green oblique zigzag lines along middle of fin. Pelvic fins with spine and first ray blue-green; remainder of fin green. Pectoral fin dark; median rays blackish; remainder of fin blue-green; tip of fin hyalin.

Stations: 33(1), 34(1), 35(2), 45(1), 54(1).

Habitat: Common in lagoon and along outer-reef, but most abundant next to coralline ridge.

Raroian name: NOGA.

Scarus sp. four.--Head and body dark reddish-brown. Fins reddish-black. Region around jaws red. Teeth pale. Life colors of specimens from

station 57: Head uniformly dark. Opercular flap black. Iris brownish-gold. Region around jaws red, fading to reddish-brown distally. Top of head and back of body almost black. Each body scale brownish-black at base, forming oblique darker lines. Breast and belly same color as remainder of body. Dorsal, caudal, anal and pelvic fins reddish-black. Pectoral fin rays dusky reddish-black, membranes hyalin. Pelvic fins with submarginal black line, hyalin tips.

Stations: 45(2), 57(2),

Habitat: Observed on outer reef flat feeding at high tide and along the shore reefs north of Garue Pass.

Raroian name: The natives have a name for this species but could not remember what it is.

Scarus sp. five.--Dusky black band behind pectoral on back. Believed by Raroians to be the same as Scarus two but that does not have dusky markings. Otherwise this species is light colored. The life colors of the specimen from station 47 show a narrow black edge to the spinous dorsal and outer long caudal rays. There is a narrow submarginal dusky vertical black line at middle caudal rays. Anal fin with dusky black submarginal line. Pelvic fins pale. Pectoral fins pale except for dusky black upper long ray. Upon re-examination of this specimen one week after preservation in formalin it was noted that there was a faint reddish area behind the black body band; this was not particularly noticed in life.

Stations: 21(1), 33(1), 47(1).

Habitat: Observed in lagoon along shore.

Raroian name: KUKINA.

Scarus sp. six.--Characterized by a red line from rictus across body to anal fin origin. Caudal fin lunate. Small spots present over head above mouth. Life colors of tagged specimen no. 2304 from station 33: Body and head background color bright solid green which is not darker above. Head with reddish-orange markings which ventrally shade into orange and pink. Upper lip bordered by orangish-red line that extends across operculum in horizontal line to middle of pectoral fin base. Lower border of head solid pink to orange. Symphysis of lower lip bordered with reddish orange, remainder of lower lip bordered by green. Iris orange to gold, yellowish anteriorly and posteriorly. Eyeball greenish-blue. Upper half of head covered with very closely spaced reddish-orange spots that form into irregular short lines on top of head. Teeth pure white. Body anteriorly covered with very closely spaced reddish-orange spots, approximately 10 to 15 on each scale. Breast and belly orange to pink, with large green spots, abruptly green above. Body solid green below pectoral fin. Dorsal fin green, edged with a blue line, each membrane with a long orange streak, becoming elongate

and passing over the posterior membrane on last 3 membranes of fin. Caudal fin edged dorsally and ventrally blue-green. Center of fin with a vertical green crescent edged in blue. Anal fin with basal 2/3 of fin solid orange-red; outer edge of fin narrowly bordered with blue that shades into a green edge. Pelvic fin edged in bluish-green on first spine and ray; middle of fin yellow-orange tinged with red. Pectoral fin blue, yellow across base; first ray blue-green, extreme tip reddish.

Stations: 33(1)

Habitat: Observed only once at Raroia but natives say it is fairly common around the reefs.

Raroian name: TOTOKE.

Scarus sp. seven.---Head with blue-green lines on orange background; upper lip bordered by orange; two blue-green lines under lower lip. No spots on head or body. Projecting canine at rictus of upper jaw. Life colors of tagged specimen no. 2307 from station 60: Ground color of head orange, shading to green dorsally and ventrally. Teeth light orange. Upper lip orange. Lower lip bordered by a blue-green line that extends posteriorly behind rictus a short distance; another blue-green line is present immediately below. Isthmus with suffuse blue-green longitudinal mid-line. Eye with five suffuse blue-green lines radiating from it. Those above broad, continuous across interorbital; interrupted above and behind eye into distinct spots. Lower posterior edge of operculum shades into light green. Iris gold, dark blue-green above. Nape and occiput blue-green, particularly intense before dorsal origin. Cheeks and upper posterior half of head orange. Body green, tinged with blue, shading into light green below. Edge of each scale orange to orange-brown, particularly distinct on back, fading out to solid green on breast; brightest green on caudal peduncle. Dorsal fin edged with a blue-green line extending to penultimate ray. Base of fin with a very narrow blue-green line; posterior region of spinous dorsal and all of soft dorsal with blue-green spots on the middle of each membrane. These spots continue on all soft rays, becoming larger and vertically elongate posteriorly. Remainder of fin solid orange. Caudal fin green, tinged with blue; center of outer filaments pale orange, that is connected vertically across middle of fin. Edge of middle ray pale black. Anal fin solid blue-green except for wavy longitudinal orange band near base, that curves out to near tip of fin on last rays. Pelvic fins blue-green on spine and first soft ray; remainder of fin pale orange, pale green at tip. Pectoral fins solid blue-green on upper rays, bordered posteriorly by reddish-brown; base of posterior rays blue-green; outer region of lower rays pale yellow-orange.

Stations: 60(2).

Habitat: Observed on shore reefs, east side of lagoon.

Raroian name: HOMOHOMO.

Scarus sp. eight.--Teeth solid green. Body solid brown tinged with red. Young with white spots on side of body. Life colors of specimen from station 63: overall dark brown, tinged with red. Anterior edge of pelvic fin green, remainder more reddish than body.

Stations: 33(1), 35(1), 58(1), 60(1), 61(2), 63(1).

Habitat: Common in lagoon, but not abundant at any particular locality.

Raroian name: KUTU.

Scarus sp. nine.--All green. Scales on body with white edges, forming vertical oblique lines. Green lines on head consisting of two broad bands extending from rictus to eye. This species does not grow over 6" in length according to natives. Life colors of specimen from station 28 one month after preservation: General color of head greenish-white. Markings on head solid green. Lips bordered with green and a broad distinct green band passes from rictus to eye. Another green band is present below lower jaw that is continuous below, ending before a vertical from eye. Mid-ventral region of head with a green line from anus to green marking below lower jaw. Two green lines extend from posterior border of eye towards opercular margin, becoming suffuse on body. No markings on top of head. Body green, anteriorly pale greenish-white. Breast and belly with a white band next to mid-ventral green line. Region below pectoral fin solid green. Brightest green on caudal peduncle. Dorsal fin with a green edge that is submarginally bordered by a black line. Base of fin with bright green to bluish-green spots. Middle of fin pale white, with a pale green spot in center. Anal fin the same. Caudal fin with upper and lower rays solid green. Middle of fin abruptly pale white except for two irregular vertical green bands. Outer region of middle rays pale white. Pelvic fins anteriorly and posteriorly green. Middle of fin pale green. Pectoral fin hyalin. Base of pectoral fin with a vertical black band.

Stations: 13(2), 28(1), 66(2).

Habitat: Observed in lagoon and in Garue Pass. Fairly common at Raroia.

Raroian name: MAKERE.

Scarus sp. ten.--Dusky white to pure white. Moderately deep bodied. Natives say this species does not grow more than 4" in length. Life colors of specimens from station 23 one month after preservation: Overall dusky white. Head dusky black at margins of preoperculum and operculum. Iris gold shading to black above. Fins pale white. Dorsal and anal shading to pale dusky black at edge, margin narrowly hyalin. Caudal same as dorsal and anal in one specimen, without shading in other two.

Stations: 23(3), 28(3).

Habitat: Observed on coral heads and shore reefs in lagoon. Moderately common at Raroia.

Raroian name: PITIKA PUAGARI.

FAMILY MULLIDAE

Goat Fishes

Six species of goatfishes are recorded from Raroia and probably twice as many occur there. Adequate collections could not be obtained and as a result the field data is brief. Most of the species seem to be wide-ranging in various habitats around the atoll from enclosed brackish pools to over the coralliferous outer bench. Over half the goatfish population at Raroia appears to be concentrated in inter-islet channels, particularly on the lagoon side. According to the natives, large adults are most abundant in Garue Pass. Each species has a definite Tuamotuan name. The natives utilize all larger goatfishes for food.

Parupeneus bifasciatus (Lacépède).--Two vertical bands on side of body and blackish saddle on caudal peduncle. Second dorsal spine strong. Life colors: Head blackish above. Upper jaw, opercles and snout tinged with red. Underside of head white. Nape reddish-black. Vertical black stripes on body moderately suffuse. Blackish saddle on caudal peduncle with considerable red. General body color yellow on edges of scales and orangish-red on bases of scales. First dorsal fin orangish-red, each membrane yellowish anteriorly. Second dorsal black basally and at edge; orangish-red and blue irregular lines alternating in between. Caudal fin black dorsally and ventrally; general color orangish-red with blue spots. Anal fin similar to dorsal with a blackish edge, remainder of fin with alternating wavy blue and orangish-red lines. Pelvic fins anteriorly edged in white, then blackish to tip; remainder of fin reddish-black. Pectoral fin pale yellow.

Stations: 33(1).

Habitat: Abundant in Garue Pass.

Raroian Name: MOAGA.

Parupeneus trifasciatus (Lacépède).--Black saddle on caudal peduncle preceded by a broad brilliant white area. Life colors of specimens from station 45: Head and body rose to reddish-orange, shading to pale yellow below. Lips yellow. Barbels pale red basally for two-third the length, tips pale yellow. Operculum reddish-orange. Iris gold, narrowly ringed with red around lens. Body with three suffuse reddish-brown vertical bands that extend ventrally to a level from top of pectoral fin. Saddle across caudal peduncle solid black in life, reddish-black after several weeks in preservative. White area between last

pale band and black spot the most conspicuous marking when alive. In preservative rosy with considerable pure white above. Lower part of body pale yellow to white, a pale red streak above anal fin. Base of caudal fin orange-red behind black spot. Spinous dorsal with pale red rays and yellow membranes. Soft dorsal with yellow on outer half and red on basal half. Last ray black. Caudal fin yellow orange. Anal, pelvic and pectoral fins yellow.

Stations: 23(1), 45(2), 61(7).

Habitat: Scattered individuals noted in lagoon on shore reefs and around coral heads.

Raroian name: KAVETI.

Parupeneus barberinus (Lacépède).--First dorsal spines elongate. Dark streak present down back. Caudal peduncle with a black spot. Life colors of specimen from station 33: General ground color pink to reddish; purplish above. Head dusky black to purple above, shading to pink below. Only markings on head are bright blue lines around eye. Lips dusky black above to reddish on lower lip. Iris narrowly ringed orange-red around lens. Remainder of iris mottled blue and green and yellow. Blue markings around eye consisting of 7 lines radiating toward snout, across interorbital, and posteriorly across operculum. Blue lines present on pre-opercular border. Body dusky above, with a pale black longitudinal line extending posteriorly from a level from eye, shading out below soft dorsal. Black spot on caudal peduncle covering lateral line scale and half of neighboring scales above and below. Breast and belly white. Body below longitudinal line pale red, particularly near edge of each scale. Spinous dorsal black on first membrane, tips of rays blackish; posteriorly membranes dusky. Soft dorsal membranes pale green and red, rays dusky. Caudal fin dusky pale black. Anal fin hyalin with oblique blue wavy line. Pelvic fin edged with black, first rays pale red, posterior rays hyalin. Pectoral fin dusky pale brown on rays; membranes hyalin.

Stations: 33(1), 60(1).

Habitat: One young seen on small coral head in lagoon near Teremu Islet. Large adults common in Garue Pass and in 20-40' depths around the bases of lagoon coral heads.

Raroian name: TAKIRE.

Mulloidichthys auriflamma (Forskål).--Teeth of lower jaw villiform. No dark markings on head or body. A longitudinal yellow stripe present on body. Life colors of specimens from station 22: Head with suffuse red on snout, occiput, nape and opercles; yellowish behind eye and on lower half of head. Body reddish, with a median lateral yellow band passing through the lateral-line posteriorly. Above and immediately below yellow band there tends to be a pale longitudinal line on each scale

row. Vertical fins yellowish-orange except for caudal fin which is pure yellow. Pelvic and pectoral fins yellow-orange with a tinge of red.

Stations: 22(2), 35(27).

Habitat: Small schools observed on lagoon shore reefs, and on outer reef flat. Large schools observed in inter-islet channels.

Raroian name: KUO.

Mulloidichthys samoensis (Günther).--General color light yellow to yellowish-orange on head and body. A mid-lateral longitudinal stripe is broken by an irregular black spot above pectoral fin tip. Head with yellow lines radiating from eye, on cheeks and operculum. Dorsal fins light yellow. Caudal fin orange. Anal fin tinged with red, as are pelvic fins. Pectoral fins light yellow. Life colors of specimen from station 58: Lips tinged reddish. Opercular border yellow-orange, operculum with a large pale red area ventrally. Iris silvery yellow. Underside of head, breast and belly pure white, except for a pale red spot before each pelvic fin. Top of head and back of body dusky, tinged with pale greenish-yellow. Spinous dorsal anteriorly yellow-orange at base shading into red at tip; posterior region of fin hyalin. Soft dorsal rays pale yellow, membrane brighter yellow. Caudal fin uniform orange. Anal fin tinged with yellow. Pelvic and pectoral fins hyalin, rays tinged reddish.

Stations: 9(4), 11(1), 16(3), 22(2), 23(12), 28(4), 44(1), 45(2), 49(1), 58(1), 60(2), 61(5), 65(1).

Habitat: Widely scattered in small schools around entire atoll in lagoon and on outer reefs.

Raroian name: VETE (large), KOUMA (small).

Genus one, sp. one.--Probably young of adults already discussed. A free-swimming goatfish blue above to silvery below.

Stations: 22(2).

Habitat: Small schools observed at night on outer reef flat on west side of atoll.

Raroian name: KOUMA (general name for small goatfish).

FAMILY CARANGIDAE

Jacks

Eight species of carangids were taken at Raroia, approximately one-half the number occurring at this atoll. The expedition did not have the

proper gear to obtain a more complete collection. CO_2 spear guns and adequate hook and line fishing gear would have helped considerably. Carangids are particularly abundant in Garue Pass and along the outer reef edge, but also are common throughout the lagoon in open water.

The natives have names for each species of carangid and know them well. There was no hesitation in naming specimens. The natives have superstitions about spearing carangids and Bengt Danielsson will include them in his report. All the carangids are used for food by the natives and are avidly speared along the coralline ridge and in the deeper inter-islet channels. Natives also troll for them and occasionally take them by hand line fishing near the bottom. All specimens were obtained by spear and trolling.

Decapterus sanctae-helenae (Cuvier).--Six rays in first dorsal plus two behind. One finlet behind dorsal and anal fin, operculum with a black spot. Life colors of specimens from station 54: General color silver. Top of head black. A suffuse vertical black spot on posterior edge of operculum. Upper side of body blue. A suffuse iridescent stripe down mid-lateral region of body, onto posterior keels. Body iridescent silver below. Fins hyalin except outer caudal rays and upper pectoral rays dusky black. First two soft pelvic fin rays with scattered melanophores.

Stations: 54(20).

Habitat: This fish moves into the lagoon at Raroia during certain seasons of the year. It is a food fish prized by the natives, who catch them in stone traps and by herding schools onto shore with woven palm branches. During the period we were at Raroia this species was particularly abundant near Garue Pass in the lagoon on the west side of the atoll.

Raroian name: KOPERU.

Scomberoides sancti-petri (Cuvier).--Life colors of specimens from station 56 immediately after capture: Iridescent silver overall. Lower part of head, breast and belly silver white. Dorsal fin black, including last soft rays. Caudal fin black except for silver scales which are iridescent blue. Anal fin with a large black blotch in middle of anterior soft rays, covering first four rays. Remainder of fin hyalin, except for dusky black pigment on anterior edge of each posterior soft ray. Pelvic fin with brownish-black streaks on first and second membranes. Anterior three membranes and rays otherwise yellow with white edge. Remainder of fin hyalin with white tip. Pectoral fin dusky black, hyalin at posterior edge.

Stations: 33(2), 56(1).

Habitat: This species is moderately common in the vicinity of Garue Pass. Individuals are often seen in open water around coral heads in the lagoon. Natives take it with hook and line and value it for food.

Raroian name: RAI.

Caranx adscensionis (Osbeck).--Color almost solid black. Approximately 25 scutes along mid-lateral line. Life colors of specimen no. 2305 from station 33: Head, body and fins black, without markings. Head and body iridescent. Iris iridescent silver; orbit edged with a black line around the anterior border. Lips black as head and body. Body scutes jet black. Spinous dorsal dusky black at base shading to black at tip. Soft dorsal with jet black rays; membranes pale black at base shading to solid black at tip. Caudal fin pale black at base and along outer edge of lobes, shading to solid black posteriorly; fin narrowly edged in white. Anal and pelvic fins same color as dorsal. Pectoral fin black..

Stations: 33(4), 62(2).

Habitat: One of the most abundant carangids at Raroia; widely distributed in the open water inside and outside the lagoon. Particularly abundant in Garue Pass. Especially prized by the natives for food. They take this species with spears along the outer reef edge and by hook and line in Garue Pass.

Raroian name: RUHI (large), RUHI PEPE (small).

Caranx armatus (Forskål).--Twenty-eight soft rays in dorsal fin. First dorsal and anal soft rays long. Lateral-line gently arched. Body with yellowish-brown spots. Life colors of specimen from station 58: General color iridescent silver, bluish above. Body with scattered brown (yellow edged) spots on mid-lateral region of body. Vertical fins black, white edged. Pelvic fins pale black, edged hyalin. Pectoral fin with upper rays dusky black, lower membranes hyalin. Iris golden, irregularly black at lens border.

Stations: 29(1), 58(1), 59(1).

Habitat: Fairly abundant in open water outside and inside lagoon. Natives often take this species with spears and value it for food.

Raroian name: NAENAE.

Caranx speciosus (Forskål).--Life colors of specimen from station 59: Solid iridescent golden yellow over head, body and all fins. Head with black band obliquely forward through eye. Body with numerous vertical black bands, alternating narrow and broad.

Stations: 59(1).

Habitat: Rare at Raroia; one specimen seen and taken in surge channels on the west side of the atoll.

Raroian name: REREIOGA.

Caranx melampygus Cuvier.--40 scales on straight section of lateral line. Lateral-line with a high arch over pectoral fin. 23 soft dorsal rays. Black spots on back. Life colors of specimen from station 35 one month after preservation: Black spots present on back down to a level from pectoral fin. General color brassy yellow to black on back. Iris with reddish-orange spot anteriorly and a vertical reddish-orange line behind lens.

Stations: 35(2), 58(1).

Habitat: Abundant in open water outside and inside lagoon. Natives often take this species with spears and value it for food.

Raroian names: TATAHAUTA (very large), PARUKU (large), PAAIHERE (medium, taken from Tahitian), RUPO (small).

Caranx ferdu (Forskål).--Scutes and shoulder girdle normal. Soft dorsal with 32 rays.

Stations: 7(1).

Habitat: Observed and taken at coral heads in lagoon. Natives value this species for food and say that it occurs both inside and outside of the lagoon.

Raroian name: PAKEVA.

Caranx sp. one.--Lateral line gently arched above pectoral fin. Dorsal with 23 soft rays. Scattered black spots over top of head and back of body. Life colors of specimen from station 63: Head iridescent blue above, shading to silver below. A few black scattered spots over top and side of head. Iris gold. Lips pale black. Body iridescent blue above shading to silver below. Upper two-third of body covered with irregular black spots. Lateral line scutes yellow anteriorly. Spinous dorsal hyalin, tinged with blue. Soft dorsal blue, anterior edge black. Caudal fin yellow on outer rays, bluish to bluish-black on posterior edge. Anal fin blue, with white edge. Pelvic fin hyalin, anteriorly dusky. Pectoral fin pale, dusky black above, yellow distally, and hyalin ventrally.

Stations: 19(1), 60(1), 62(1), 63(1).

Habitat: Abundant in open water in lagoon and around outside of atoll. Valued for food by natives.

Raroian name: PARUKU.

FAMILY THUNNIDAE

Tuna & Wahoo

The Raroians said that several kinds of tuna are abundant around the atoll but never caught one during the period we were there, despite daily attempts to do so. Acanthocybium is common about the atoll and approximately five were taken from June to August by trolling. One of the adults was preserved. The natives also say that Coryphaena occurs about the atoll but none were obtained.

The natives make their own metal hooks and mother-of-pearl and feather lures for trolling for thunnids. Bengt Danielsson has prepared descriptions of the hooks and fishing methods and will include them in his report.

Acanthocybium solandri (Cuvier).--Head and body blue above shading to white on belly. Body with numerous vertical blue bars.

Stations: One taken (about 4' long) near Garue Pass on the inside of the lagoon July 3, 1952. A few others were taken by the natives, but were not seen.

Raroian name: ROROA.

FAMILY PARAPERCIDAE

Only one species was noted at Raroia, but there may be other smaller forms in the unrecorded material. The natives use the same name for it as for lizard fishes (Synodontidae) but do not use it for food.

Parapercis tetracanthus (Bleeker).--Dorsal fin continuous. Black spots present on caudal fin. Life colors of specimen from station 11: ten vertical bands on side of body that are dark grey or brownish-grey. Fins hyalin except caudal fin which has black spots over membranes and rays. General ground color of head and body mottled grey and brown.

Stations: 11(1), 14(3).

Habitat: Confined to inter-islet channels under rocks in very shallow water. Observed only on west side of atoll.

Raroian name: KARAEA.

FAMILY BLENNIIDAE

Blennies

There are more species and individuals of Blenniidae at Raroia than any other fish families, with the possible exception of Gobiidae. Only a small percentage of the material was recorded in the field, totalling 26 species. Probably 10 or more species will be added after more detailed study. Without a doubt the main center of blenny distribution, both in number of species and specimens, is on the outer reefs of the atoll on the reef flat [illegible] and in the surge channels, particularly the latter. Many of the species are strikingly restricted in habitat, and occur only in definite locations.

The genus Cirripectes is completely confined to the outer reef surge channels, down to a depth of about 25'. A few scattered individuals were found in inter-islet channels, but compared to the thousands of Cirripectes seen in the surge channels it is obvious that they had strayed out of their normal habitat. This genus was noted to come up on the coralline ridge at night, presumably to feed. At rotenone stations in the surge channels, the number of Cirripectes killed invariably exceeded that of all other fishes combined, indicating that this genus is undoubtedly the most characteristic form of the surge channels.

A few species of Salarias are also restricted to the surge channel zone, but this genus is actually more typical of quieter water. Many species are extremely abundant in the tide pools next to shore on the outer reefs and in the inter-islet channels. To a lesser extent this genus is abundant in the lagoon around coral heads and shore reefs. I doubt that all species of Salarias occurring at Raroia were taken and the problem of recognizing sexual variation versus species variation is a troublesome one.

All blennies are called KOKOROHUE by the natives; none are used for food.

Cirripectes brevis (Kner).--Characterized by 50-60 tentacles in fringe across nape. Black spots separate, not arranged in groups. Life colors of specimen from station 45: Ground color brownish-green. Spots over head and body. Iris gold around lens, shading to dusky orange. Spots on head tend to join in short lines. Front of snout with two broad vertical black bands that cross upper lip--do not extend on lower jaw or underside of head. Front of snout and lower side of head pale blue. Body darker than head, spots become much smaller than on head. Belly yellowish. Posteriorly ground color becomes brown. Side of body with five indistinct broad vertical darker bands that shade out below lateral-line. Spinous dorsal with a row of black spots directly on base. Remainder of membranes pale black except for broad oblique anterior margin. Rays reddish-black, more red on tips of anterior rays. Soft dorsal dusky black overall, a row of black spots on lower part of membranes next to back, tips of first three rays red. Caudal fin membranes dusky black, the rays black except tips of upper rays red. Anal fin dusky black, outer one-fourth solid black. Pelvic fin dusky

black. Pectoral fin colored like head on basal half;brownish-green with large black spots. Posterior half of rays brown, membranes hyalin.

Stations: 45(1).

Habitat: Outer reef surge channels on west side of atoll. Only one specimen recorded.

Cirripectes leopardus (Day).--Characterized by approximately 32 tentacles in nape fringe. Spots on body often arranged in groups of 4 and 5. Life colors of specimen from station 58. Ground color light blue to pale brown. Head with dark brown spots surrounded by a blue network. Lips covered with small brown spots. Iris gold; dorsal, ventral and posterior margin with a black spot; a suffuse longitudinal gray outer margin anteriorly. Fringe tentacles brownish-black to black. Bottom of head with brown spots similar to side of head. Supra-ocular fringe black with white tip. Body with light brown spots arranged in groups of 4-8 over entire body, including belly. Spinous dorsal with 4-5 light brown spots on each membrane, the edge dusky black. Edge of first ray black; otherwise membranes hyalin pale brown. Caudal fin orangish-brown, edged in black. Indistinct spots on rays. Anal fin dusky black, with suffuse dark spots. Pelvic fins dusky black. Pectoral fin with brown spots out middle rays to end of rays. Upper and lower rays dusky black.

Stations: 26(1), 27(1), 58(1).

Habitat: Outer reef surge channels on west side of atoll. Only three specimens seen.

Cirripectes sp. one.--Closest to Cirripectes jenningsi Schultz. Life colors of specimen from station 17: General color reddish-brown. Head and body evenly scattered metallic blue spots, those on head tending to be faintly outlined in black. Body with faint vertical bands (approximately 6). Fins without distinct markings. Dorsal pale basally, blackish on outer half. First two rays reddish-brown. Metallic blue spots on bases of most soft dorsal rays. Lower caudal lobe black. Upper posterior portion of caudal fin pale. Anal fin uniformly pale black. Tips of lower pectoral rays pale black. Tips of pelvic rays pale black. Belly and undersurface of head greenish-white. First two anal rays in males swollen.

Stations: 17(55).

Habitat: The most dominant and largest Cirripectes in the surge channels on the west side of the atoll.

Cirripectes sp. two.--Perhaps Cirripectes sebae. Life colors prepared at station 17: Ground color brown to reddish-brown. Head brown with light red spots and streaks. Body brown above, reddish below (particularly

over anal fin) with a median longitudinal pale band disappearing on caudal peduncle. Fins reddish, particularly dorsal fin. Spinous dorsal black basally. Soft dorsal reddish-brown basally, brown distally. Anal fin red at base, black for remainder of fin except tip of each ray and membrane abruptly lighter. Caudal fin outer rays red, black in center of fin. Pectoral fin with outer rays red, upper and lower rays brown. Pelvic rays reddish-brown. Belly and underside of head tan.

Stations: 17(10), 58(30).

Habitat: Outer reef surge channels on west side of atoll.

Cirripectes sp. three.--Life colors of specimens from station 17: General color brownish black. Head with a prominent black spot on preopercle, edged in pale blue. Metallic blue spots on head body. Spots on body arranged in irregular vertical rows. All fins except caudal uniformly black. Caudal with outer rays red and central rays black. Belly and ventral surface of head light brown.

Stations: 17(71), 58(53).

Habitat: The most abundant Cirripectes in the outer reef surge channels on west side of atoll.

Cirripectes sp. four.--Life color notes of material from station 17: General color brown. Large brown spot on operculum edged in pale light blue. Three pairs of metallic light blue spots on top of head. Another light blue metallic spot on operculum. Sides of body anteriorly with narrow bluish-brown vertical stripes. A large brilliant red patch on posterior part of body and caudal peduncle, preceded by a black blotch dorsally. Black blotch grades into brown stripes ventrally. Fins without markings. Caudal fin reddish above and below, grading into brownish-black centrally. Dorsal and anal dark brown. Lower pectoral ray tips dark brown, remainder of fin light. Tips of pelvic rays brown. First two dorsal rays lighter brown, not prolonged. Iris gold, upper and posterior rim black. Nasal flaps red.

Stations: 17(2), 58(2).

Habitat: Moderately common in the outer reef surge channels on west side of atoll.

Cirripectes sp. five.--Life color notes of material from station 17: Ground color brown overall. Head and body with darker brown vertical stripes which become indistinct ventrally. Between these stripes are metallic light blue spots. Nasal flaps and supraorbital cirri yellowish-orange. First two dorsal rays reddish brown. Remainder of dorsal fin brown to blackish brown on the rays. Membranes light. Lower part of spinous dorsal membranes dusky black. Caudal fin blackish, particularly middle rays. Outer rays tinged with red. Anal fin black. Tips of rays white.

First ray glandular. Pectoral fins with tips of lower rays light brown. Remainder of fin hyalin. Tips of pelvic rays dusky brown.

Stations: 17(12).

Habitat: Outer reef surge channels on west side of atoll.

Cirripectes sp. six.--Life colors of specimens from station 17: Ground color light brown with seven darker brown vertical double bars on body. Numerous metallic light blue streaks and spots over head and body. Young red. Color tends to blend with coralline algae. Supraorbital cirrus branched.

Stations: 17(18).

Habitat: Outer reef surge channels on west side of atoll.

Cirripectes sp. seven.--Distinctive colors plain brown on head and body. Broad red margin to spinous dorsal. Life colors of specimen from station 57: Head and body uniform brown without markings. Side of body with a suffuse, irregular, bluish-brown longitudinal band. A light brown band across base of caudal fin on caudal peduncle. Belly bluish-brown. Head brown, brownish-white below. Upper lip brown except abruptly light brown for posterior third of length. Interorbital reddish brown. Iris blue. Anterior rim dusky red. Spinous dorsal with red edge; base of fin abruptly black. Soft dorsal black fading to hyalin on anterior rays. Caudal fin dusky black, fading to hyalin at edge on upper rays. Anal fin black, with abruptly hyalin edge. Pelvic fins dusky black. Pectoral fin hyalin above, pale yellowish-black on lower rays. Pectoral fin edged black. Caudal fin rays reddish-black.

Stations: 17(5), 57(1), 58(6).

Habitat: Outer reef surge channels on west side of atoll. One specimen found in inter-islet channel above Garue Pass, west side of atoll.

Enchelyurus ater (Günther).--Solid black. Dorsal and anal fins joined to caudal.

Stations: 7(2).

Habitat: Fairly abundant on the sandy tops of lagoon coral heads and to a lesser extent on the lagoon shore reef tops. It lives between depths of 2-25' in holes at the base of coral growing in sandy areas.

Salarias zebra Vaillant and Sauvage.--Body with approximately six sets of double vertical bars. Very dark coloration. Fins black. Cirrus over eye simple. Occipital flap present.

Stations: 8(31), 10(52), 11(40), 14(5), 22(6), 37(1).

Habitat: One of the dominant blennies in the tidepools along the inner edge of the outer reef flat around the atoll and in the inter-islet channels. Rarely seen elsewhere on the atoll.

Salarias gibbifrons Quoy and Gaimard.--Distinctive colors consist of black spot on first dorsal membrane. Body with approximately eight vertical double bars. Life colors of specimens from station 17: Ground color brownish-white. Head and body reticulated in brownish-red. Vertical bars with light brown between. First dorsal with oblique series of reddish brown spots. Second dorsal with oblique series of black spots. Caudal fin with vertical rows of black spots. Anal fin with two or three suffuse reddish-brown spots, belly white. Underside of head greenish-white. Pelvic fins hyalin. Life colors of specimens from station 58: No cirrus on nape. Numerous red spots on lower side of head and before pectoral fin, but otherwise no red spots on body. Iris green, narrowly edged in gold. Seven reddish-brown streaks from lens. Anal fin blackish distally, each membrane with a narrow pale red streak near posterior edge of each ray. Otherwise basal portion pale. Caudal fin edged in yellow, hyalin except for black spots. No blue spots on body. Tips of first two spinous rays yellow, and submarginally bright red. Pectoral fins with a vertical row of reddish-brown spots near base. Belly white. Dorsal fins hyalin except for described markings. Head greenish above and anteriorly. Upper lip with an irregular longitudinal red line and red reticulations, green above at symphysis. Lower jaw edged in dusky black, red spots laterally.

Stations: 17(49), 58(12).

Habitat: Outer reef surge channels on west side of atoll. Same distribution and abundance as Salarias sp. 7.

Salarias edentulus Bloch.--No canines at corner of lower jaw. General color light brown with 4-6 double vertical bars. A simple cirrus over eye. Mottled red and brillian blue spots on body.

Stations: 7(4), 8(84), 9(5), 10(26), 23(1), 28(3), 38(9).

Habitat: On lagoon sand-topped coral heads and sandy shore reefs, occurring between 2-10' depths.

Salarias sp. one.--Supraocular tentacle fringed. Simple tentacle on nape. Black streak behind eye. Sides of body spotted in groups of four without stripes. Vertical stripes down caudal fin. Dark spots on dorsal fins.

Stations: 10(10), 22(1).

Habitat: Shallow tidepools, next to shore on outer reefs, west side of atoll. Not observed elsewhere.

Salarias sp. two.--Caudal joined to dorsal fin. Long nuchal cirrus. Simple ocular cirrus. Caudal fin yellow, with light edge. Dorsal fins spotted, not streaked. Caudal rounded. Life colors of specimen from station 22: Ground color yellowish-green. Head streaked and spotted by numerous reddish lines. Vertical bars on body brownish-orange. Spots on body and dorsal and anal fins orange-red to red. Dorsal fin with green as well as reddish-orange spots. Caudal fin with reddish-orange spots at base, but otherwise lacking markings. Anal fin edged white. Very light black submarginally. Orangish-red spots on basal half of fin. Pectoral fin with orangish-red streaks at base of rays, remainder of fin pale yellow. Belly crossed by six dusky lines. Iris orange, without streaks, three faint orange spots around lens.

Stations: 22(1).

Habitat: Inter-islet channel north of Garue Pass, west side of atoll. A strikingly beautiful species that is apparently rare at Raroia.

Salarias sp. three.--Lower caudal lobe longer; upper rays truncate. Supra-ocular cirrus simple. Tiny cirrus on nape. Reddish-orange markings over all. No dark markings. Life colors of specimen from station 22: Ground color yellowish-brown. All stripes and spots orange-red except for a few blue spots. Head with red spots above parallel from lower border of eye. Lower part of operculum and suborbital region sparsely spotted. Upper lip and tip of snout between lip and nostrils densely spotted. Blue spot behind lower border of eye. Vertical orangish-red bar behind eye. Gular region pale. Iris orange, with an incomplete (opening at upper posterior corner) orangish-red ring. Body with seven sets of vertical bars; each set with metallic blue spots above and below. Ventrally no spots. First dorsal with short streaks along the rays; membranes hyalin. Soft dorsal lightly specked with orangish-red anteriorly, hyalin posteriorly. Caudal fin without markings, slightly darker ventrally. Anal fin completely lacking markings. Pectoral fin with orangish-red streaks basally.

Stations: 22(3).

Habitat: Tidepool next to shore on outer reef flat north of Garue Pass, west side of atoll.

Salarias sp. four.--Distinctive colors black on vertical fins. Paired fins completely without markings. A simple cirrus over eye. No cirrus on nape. Life colors of specimen from station 22: Ground color brownish green. Pale greenish-brown bands on body. Three mid-lateral elongate metallic blue spots on body. No spots anywhere else. Head plain, with a suffuse vertical black band from eye to mouth across upper lip; also a pale black stripe through anteroventral border of eye. Iris yellow-green. Dorsal fins dusky black basally, white distally. Caudal fin white above, black below; the lower rays are longer. Anal fin dusky black distally, black basally, the last rays all black.

Stations: 22(25).

Habitat: A fairly common species in the inter-islet channels and in the shallow tide pools next to shore on the outer reefs, west side of atoll.

Salarias sp. five.--This species is similar to Salarias sp. four, but differs by (1) having a double row of blue spots instead of single spots, (2) having spots in the first dorsal instead of a black base, (3) the presence of a nuchal cirrus in both males and females versus absent. The males of sp. five have the median caudal rays prolonged to a point. The females have the lower caudal rays longer than the upper. Life colors of specimens from station 22: Ground color greenish-brown, or green. Head faintly mottled green. A vertical black streak behind eye. Iris outlined in black at upper posterior and lower anterior borders. Iris otherwise yellow. A faint dark streak between eye and upper lip. Tip of snout mottled darker. Eight sets of green vertical bars. Two rows of blue spots on side of body, generally five for lower, variable for upper. First dorsal fin light, with two rows of black spots. Second dorsal brown basally, hyalin for remainder of fin. Caudal fin with a pale black median spot near base of middle rays, and pale black lower rays. Anal fin as in Salarias sp. four. Pectoral fin completely without markings, pale.

Stations: 22(10).

Habitat: Shallow tide pools next to shore on the outer reefs, west side of atoll.

Salarias sp. six.--This distinctive species is characterized by a bright blue spot ringed in red on the side of the body above the middle of the anal fin. Supraocular cirrus simple. Long cirrus present on nape. Fins pale black at edge. Life colors of the specimen (tag no. 2303) from station 58: Ground color yellow-green, pale to white below. Head bluish-white on throat. Lips anteriorly green shading into pale blue distally. Numerous red spots and short red lines on snout, interorbital, around eye, and on operculum. Suffuse reddish-orange on nape. Iris gold. Eyeball yellow-green. Body with seven brown double vertical bands as in Salarias zebra. Region behind pectoral fin and lower side of body above anal fin covered with red spots. Between each dark vertical band are irregular orange-red lines and spots that fade out anteriorly mid-laterally. Red spots over entire body posteriorly. Dorsal fin with red spots near base of fin. Yellow-green of body extends dorsally onto the fin around the red spots. Both dorsal fins with another series along middle. Remainder of fins pale black with tips of rays almost hyalin. Soft dorsal with red spots over all of fin. Caudal fin uniformly pale black with yellowish tinge; tips of rays light. Anal fin same as spinous dorsal. Pelvic fins pale. Pectoral fins yellow, with orange-red markings on basal third of rays.

Stations: 58(1).

Habitat: Apparently this species is limited to the outer reef surge channels on the west side of the atoll.

Salarias sp. seven.--Distinctive coloration of marbled red over body, head and dorsal fins. Blue spots along side of body. Supraocular cirrus simple. Small cirrus on nape. Life colors of specimens from station 58: Head marbled red, except gular region white. Red mottling filled in with pale blue, especially around eye, and upper jaw. Body with eight vertical bands, fading out ventrally; back marbled like head. Lower part of sides with approximately three series of longitudinal elongate blue spots. Belly white. Dorsal fins completely mottled red, the circles not arranged in any lines; a black spot near top of first membrane. Soft dorsal narrowly edged in black at tips of rays. Caudal fin pale black on dorsal and ventral edges, mottled red on middle of fin shading to dusky red at posterior tip. Anal fin pale red for basal half of fin and dusky black for outer half. Pelvic fin white. Pectoral fin mottled red on basal one-third, remainder of fin hyalin.

Stations: 45(1), 58(2).

Habitat: A dominant form in the outer reef surge channels living under rocks, in sea urchin holes, and in cracks in the coral. It is found from 25' in the bottom of the deeper surge channels to the lithothamnion ridge at the edge of the reef flat. This species is the same color as the encrusting algae.

Salarias sp. eight.--Supraocular cirrus fringed. A large cirrus present on nape. Body red, with broad vertical bands. Lower side of head with large metallic blue spots. Life colors of specimens from station 58: Head mottled brownish-red. Large metallic silver spots on operculum and behind eye. Lips dusky brown. Nasal flaps red. Iris gold, a black crescent above. Body with seven brownish-red vertical double bars, each bar forked ventrally. Lower half of side with large metallic silver spots. Membranes of dorsal fins hyalin; rays with reddish-brown spots. Caudal fin red at base and four vertical rows of brown spots across fin; membranes hyalin. Anal fin membranes hyalin; rays with two longitudinal series of reddishbrown spots. Pelvic fins hyalin. Pectoral fins reddish.

Stations: 58(12).

Habitat: Outer reef surge channels on west side of atoll.

Salarias sp. nine.--Cirrus above eye fringed. Cirrus present or absent on nape. Body with longitudinal blue streaks and lines. Adults with vertical fins black. Life colors of specimens from station 58: Sex with cirrus on nape: General color pinkish-red like coralline algae. Head with brown streaks, particularly prominent on bottom of head. Iris gold. Upper lip crossed by seven lines that faintly continue on snout. General head color pale reddish-blue, a pale brownish-white below. Behind eye is a large suffuse blue spot. Body with six sets

of pinkish-red vertical bars which are suffuse-not dominant. Numerous longitudinal blue spots and short streaks on body below a level from pectoral base, comprising the dominant body coloration. Belly pale white. Spinous dorsal pale brownish-black, edge white. Vertical body bands extend onto basal part of membranes. Soft dorsal with six oblique wavy white lines on pale black background. Base of fin same color as body with vertical bands extending up fin. Caudal fin crossed by five vertical black bands which fade out dorsally. Remainder of fin white. Anal fin pale black, becoming darker at tip. Basal part with white spot on each membrane and suffuse white spots out to near tip of fin. Pelvic fins pale, tinged greenish-brown. Pectoral fin pale, tinged greenish at middle, orange-brown at base. Sex without cirrus on nape: ground color bluish to purplish-red. Fins same pattern as other but blacker. Head much darker, including gular region. Vertical streaks on head indistinct. Mid-lateral region along body with a double set of intense purplish-blue spots, corresponding to an intensification of the double bar sets in this region.

Stations: 58(6).

Habitat: Outer reef surge channels on west side of atoll.

Salarias sp. ten.--Dorsal fins separated by a slight notch. Males with a high crest. Supraocular cirrus fringed. Colors of specimens from station 45 after preservation: Spinous dorsal solid black. Soft dorsal black with white edge. Caudal fin black shading to a white base. Anal fin dusky to hyalin, a submarginal black band extending length of fin. Body with six pairs of vertical bands. Female with lower fins, no crest, but the characteristic head shape is the same; fins colored the same. No cirri on nape in either sex.

Stations: 45(3).

Habitat: This species was found out of water on the sides of rocks 3-6' above the outer reef flat of the west side of the atoll. These blennies agilely climb over the vertical rock face and were reluctant to jump back into the water.

Enneapterygius minutus (Günther).--A vertical black band below eye, extending ventrally. No black marks on operculum. Body with four vertical black bands.

Stations: 7(1).

Habitat: Moderately common on sandy bottom on tops and upper sides of lagoon coral heads. Apparently it lives in holes in the sand at the bases of corals, and to a lesser extent in holes in the coral.

Enneapterygius sp. one.--Red body with conspicuous black bands across caudal peduncle. Life colors of specimens from station 58: Head brownish-

red above, white below. Snout with an irregular brownish-red stripe from eye to near tip of upper jaw. A red spot under eye. Operculum and branchiostegal membranes pale black to solid black, not continuous below. Body with three double sets of vertical red bands which do not meet below. Dorsal fins pale red. Caudal, anal and pelvic fins hyalin. Pectoral fin pale red on rays, membranes hyalin. Iris gold marked with seven red bands radiating from lens. Caudal peduncle variously solid black to striped with vertical black bands.

Stations: 58(19).

Habitat: A very abundant inhabitant of the outer reef surge channels on the west side of the atoll.

FAMILY ELEOTRIDAE

Gobies

The most incomplete field records of all are for the gobies of the families Eleotridae and Gobiidae. Since no microscope was available, adequate study could not be made of these small fishes and most collections of them were not sorted over for field data at all. Thus few habitat notes were made and this category is left off of most species.

Six species of eleotrids were recorded and probably twice as many species collected. It is a very abundant family in the outer reef flat tide pool area next to shore, in the inter-islet channels, and in the lagoon wherever there is coral, from the shore to depths of at least 40'.

The natives pay no attention to them and have no name for them.

Gobiomorphus sp. one.--Remarkably distinct color pattern of dark brown, black and white. 3 vertical dark brown stripes on body. Numerous ridges on head. Head, nape and breast not scaled.

Stations: 9(2).

Asterropteryx sp. one.--Second dorsal ray long. Longitudinal black band on back. Spine on preoperculum.

Stations: 7(13), 8(5), 9(16).

Trimma sp. one.--General color reddish brown on body and fins. Head red. Each scale edged in darker coloration. Fins relatively uniform in coloration. Tongue round, not forked.

Stations: 7(7).

Eviota sp. one.--General color bright green with darker vertical stripes.

Full size one-half inch long. Silver patch behind eye. Pelvic rays long.

Stations: 7(10), 9(1), 17(8), 50(1), 58(9).

Eviota sp. two.--This species is very small, one-half inch long, transparent. Life colors of specimen from station 53, 11 mm. in total length: General color transparent. No colors seen in fins though rays pale red. Head with a red line from front of eye to tip of snout. Short red line extends from upper posterior margin of eye to upper edge of pectoral fin. This line continues as reddish pigment covering the digestive track. Mandible with red streak along the ventral edge. Body with 13 red stripes on back that extend $\frac{1}{4}$ the distance down the side. Ventral series of vertical stripes start behind anus; 8 stripes counted that extend $\frac{1}{4}$ the distance up the side. The posterior stripes are somewhat dendritic but meet the upper stripes.

Stations: 53(1).

Habitat: Taken only by dredges operating at approximately 40' depths.

Genus one, sp. one.--This species has an elongate body with an emarginate caudal fin. Pelvic fins are close together but separate at base. A black band extends from eye ventrally to the throat. Pectoral fin with a black basal band. Life colors of largest specimen from station 45: General color of head and body white, markings only on head. Head with a broad black band from eye extending obliquely forward and meeting below on gill membranes. Iris black above and below, blue anteriorly and posteriorly. All fins white, anal fin distally pale orange. Life colors of smaller specimens apparently of opposite sex from station 45: dorsal fin and upper edge of caudal fin edged in black. Pectoral fin with a vertical black band on pectoral base preceded by a white line. Snout dusky black; 2 blue spots on operculum behind eye. Otherwise same coloration as other specimens.

Stations: 45(2), 61(3).

FAMILY GOBIIDAE

Gobies

The first paragraph under the family Eleotridae applies to the Gobiidae also. Eighteen species of gobies were recorded but this is far from the total number of species taken. Probably about 40 species of gobies occur at Raroia atoll and most likely this is too conservative an estimate. In both numbers of individuals and species it is the largest family of fishes at Raroia and occurs everywhere down to at least 35' depths. Gobies are

most abundant in the shallow outer reef tide pool area next to shore and in the inter-islet channels. The greatest variety of species occur on the lagoon coral heads, but not in as great numbers as on the outer reefs. Paragobiodon completely dominates the fish fauna of the outer reef flat between but not including the coralline ridge and shore tide pool area.

As with the eleotrids, the natives pay no attention to them, and have no names for them.

Gnatholepis anjerensis (Bleeker).--General coloration white to translucent with brown spot. A light brown spot above pectoral fin and another above eye.

Station: 7(1).

Rhinogobius corallinus Jordan and Seale.--Head broad. Eyes large, meeting on top of head. General coloration light brown, mottled grey. Black spot present on spinous dorsal. Pelvic fins close together and connected at base.

Station: 8(10).

Rhinogobius sp. one.--Third dorsal spine very elongate. Caudal fin lanceolate. Two series of spots extend down side. Fins hyalin without markings. Head, nape and breast naked.

Stations: 9(1).

Bathygobius cotticeps Steindachner.--Upper 8 pectoral fin rays long and silky. Sides of body blotched with dark vertical stripes. Tongue slightly notched.

Stations; 8(9), 10(26), 12(1).

Habitat: Commonest large goby in shallow outer reef tide pools next to shore and in inter-islet channels. Its coloration is exactly like the gravel and beachrock bottom.

Bathygobius fuscus (Rüppell).--Upper 4 pectoral rays free. Tongue slightly notched. Numerous longitudinal rows of light spots between suffuse stripes.

Stations: 8(4), 11(13), 27(1).

Bathygobius sp. one.--Upper 8 pectoral rays free and silky. Tongue slightly notched. No scales on cheeks or operculum. Life colors of specimens from station 58: General color white and dusky brownish-black. Head with a black spot behind eye. Lower half of operculum darker than remainder of head and body except for spot behind eye. Snout mottled dusky brownish-black. Underside of head white. Iris gold, shading to pale blue below. Occiput light brown, with a median longitudinal

dusky brownish-black streak. Body with 4 saddles on back, extending to mid-lateral region; behind tip of pectoral fin there is a series of 6 spots along the mid-lateral region extending to caudal fin base. Belly and breast white. Edge of dorsal fin dusky black. A broad brownish longitudinal black band extends across middle of fins. Caudal fin dusky, with suffuse brown vertical bands near base. Anal fin with a longitudinal broad pale black band across fin; tips of rays hyalin; base hyalin. Pelvic and pectoral fins hyalin. Base of pectoral fin dusky black.

Stations: 58(6).

Habitat: Outer reef surge channels.

Amblygobius sp. one.--Entirely white except for black on upper jaw. Peritoneum shows through belly wall as black. Also a black stripe is present across snout to eye and from eye to operculum edge; a narrow stripe is continuous across front of snout.

Stations: 9(2).

Zonogobius semidoliatus (Valenciennes).--Numerous vertical blue stripes on head and body which extend onto the fins.

Stations: 8(1).

Drombus tutuilae Jordan and Seale.--Tongue round. Distinct ridges on head. General color mottled black and brown. First dorsal with anterior edge dark brown followed by two brown spots. Soft dorsal fin with three longitudinal oblique stripes.

Stations: 7(1).

Paragobiodon echinocephalus (Rüppell).--Body and fins black. Head reddish-brown. Head covered with hairlike cirri.

Stations: 7(1), 9(7), 17(1), 58(1).

Gobiodon rivulatus (Rüppell).--General colors solid blackish-brown with light belly. No markings. No scales. Gill opening shorter than base of pectoral fin. Some specimens are yellow to white.

Stations: 7(2), 17(1).

FAMILY GOBIESOCIDAE

Cling Fishes

A young gobiesocid was taken at station 59, but not noted until the collection was sorted at Philadelphia. Probably there are other clingfishes in the Raroian material, but were not noticed in the field. The family Gobiesocidae has not been previously reported from French Oceania.

FAMILY BROTULIDAE

This family is usually found wherever there are caves in the coral heads and shore reefs. Since there are a great number of caves and long passages in the coral in the outer reef surge channel region, at least one species of brotulid is abundant there. The natives professed to have never seen this group until we showed them examples. Only two species seen at Raroia.

Dinematichthys iluocoeteoides Bleeker.--General color usually yellowish-green to greenish-brown, without markings. Caudal fin separate from dorsal and anal fins.

Stations: 7(3), 17(4), 58(1).

Habitat: A dominant species of the sea caves in outer reef surge channel area on the west side of the atoll between depths of 10-25'. Also occasionally found around the bases of lagoon coral heads and in caves along the bases of the lagoon shore reefs.

Brotula sp. one.--Dorsal and anal fins joined to caudal fin. Head without barbels. Color pale yellowish-brown.

Stations: 23(1), 45(2).

Habitat: Taken in outer reef surge channels and on west lagoon shore reefs.

FAMILY ECHENEIDIDAE

Remoras

While several different species of remoras were observed on sharks, only two species were collected. The natives scorn them for food and occasionally are bothered by large numbers biting on hooks before food fishes can get to them. The natives have the general term KAKARIURI for remoras.

Echeneis naucrates Linneaus.--Characterized by long body and longitudinal dark stripes.

Stations: 33(3), 60(1).

Habitat: Often schools of free swimming naucrates occur in Garue Pass, around coral heads and along the shore in the lagoon. The specimens obtained where shot, speared and hooked.

Echeneis sp. one.--Characterized by the presence of 24 plates on the disk, a solid blackish-brown coloration without markings except for longi-

tudinal black band through eye. Life colors of specimen from station 33: head with broad black band from rictus to upper edge of operculum. Fins and sucking disk black. Iris whitish-silver, lens bordered by black above and below on iris. Lips black. Pelvic fins pale black. Body solid blackish brown.

Stations: 33(1)

Habitat: Natives say this fish often prevents native fishermen from catching edible fish as it takes a hook so readily. Very abundant at pass and north of pass on west side.

FAMILY ACANTHURIDAE

Surgeon Fishes & Unicorn Fishes

The fishes of the family Acanthuridae form one of the most abundant families on the reefs, both in the lagoon and along the outer shore. Seventeen species of the genera Acanthurus, Ctenochaetus, Zebrasoma and Naso were taken, and several additional forms of Naso were seen around lagoon coral heads. The genus Acanthurus is prominent around the entire atoll, but occurs in greatest numbers in Garue Pass and along the outer and inner reefs of the west islets and coral heads. All species are in close association with coral, rarely venturing over sand or gravel bottom; Acanthurus triostegus is primarily restricted to the outer reef flats and is one of this area's main "index" species; A. guttatus and the rarer A. achilles are indicative of the surge channels next to the coralline ridge; A. lineatus was seen only in Garue Pass and yet was extremely abundant there; A. nigricans is rather rare at Raroia, and was seen only on the outer reef flat. The natives are particularly aware of the species of Acanthurus and Naso, since they form a moderately important food, the species of the latter genus being considered a delicacy. The natives are rather hazy in naming the less striking acanthurids, and HAMI is a general name applied to all the less distinctive dark species. Three species of the genus Zebrasoma occur at Raroia. Zebrasoma veliferum is moderately abundant around the lagoon coral heads and lagoon shore reefs of the west side. The natives use this species for food, but do not particularly fish for them. Z. rostratum is common only on the lagoon reefs in the vicinity of Garue Pass. Only two specimens of Z. flavescens were seen the entire summer. The genus Naso is very well represented at Raroia, there being at least seven species present; each species, however, is remarkably restricted in distribution, occurring on only definite coral heads within the lagoon and definite areas of the shore reefs. Specimens of Naso are hard to obtain, rarely succumbing to poison, and always very wary of swimmers; two species would bite on a hook, but the remainder had to be speared. The natives were very cooperative in showing me where each species of Naso occurred, but trying to obtain them was usually impossible. Naso eoume is taken by jiggling a dead adult on the end of a twelve foot spear; other adults will

then be attracted within spearing range, but it is a laborious process. Only a few natives at Raroia are skillful enough with this method to spear eoume. The genus Naso is most abundant in Garue Pass. The genus Ctenochaetus is confused with Acanthurus by the natives and the 2 species have no particular names. The natives do not use them for food. Ctenochaetus strigosus is abundant on lagoon coral heads and lagoon shore reefs of the west side of the atoll. In order to obtain a good collection of the larger acanthurids, particularly of the genus Naso, a CO_2 spear gun is indispensable. Rubber sling guns do not quite have enough range and power to get the species we lack. Time after time I would spear a unicorn fish, only to see that the spear did not penetrate deep enough to hold him. Many times we would lay a large rotenone cloud over a coral head teaming with unicorn fishes, but they always left at the first whiff, and only a few specimens of Naso lituratus were taken by this means.

Acanthurus triostegus (Linneaus).--Life colors based on specimens from station 58: Ground color dusky greenish-white to grayish-white. Head with a vertical black streak through eye. Above eye brownish black. Below eye pale black. Head whiter than body. Each stripe on body blackish-brown, bordered narrowly by orange-brown. Below pectoral fin are two spots, or a streak, either short, confined to base of pectoral fin, or longer, extending below and behind fin. Iris gold, ringed in dusky black; dark band above, extending almost to lens. Dorsal fin grey, spinous dorsal edged in black. Soft dorsal gray at base to dusky black near edge. Fin edge light. Caudal fin dusky black, its edge white, to hyalin on central rays. Anal fin dusky black with hyalin edge, darkest near hyalin edge. Pelvic fins white. Pectoral fins hyalin with upper ray edged in black.

Stations: 8(5), 9(20), 11(10),14(5), 21(1), 22(12), 23(8), 26(4), 28(2), 42(1), 45(9), 58(30), 65(5), 49(2).

Habitat: Very abundant on top of the western shore reefs in the lagoon, but moderately rare elsewhere. This species does not become as large in the Tuamotus as in the Line Islands, seldom surpassing 4" in length. Besides living on the inner western shore reefs, it is also a typical inhabitant of the outer shallow reef flat around the entire atoll, feeding at high tide and hiding along the outer reef face at low tide.

Raroian name: AKEGA.

Acanthurus guttatus (Schneider).--L fe colors based on specimen from station 58: Ground color brown with blue spots on posterior half of body, two vertical pale blue lines on middle of side. Head brown anteriorly, a vague orange-brown area from eye to mouth. Operculum bordered in light pale blue that extends narrowly superiorly to nape, joining across top of head. Lips brown. Remainder of jugular region white. Iris golden, with a ring of brown posteriorly and superiorly. Body orange to orange-brown immediately around pectoral fin. Immediately above pectoral fin blackish-brown patch. Vertical stripes extend

from back to mid-ventral region. Breast shades into white. Belly also white. Region at pelvic base to anal fin yellowish. Posterior half of body behind anterior light bluish line is covered with blue spots narrowly ringed with dark brown; spots present on caudal peduncle posteriorly to behind a vertical from caudal peduncle spine. Dorsal fins brown basally, covered with blue spots as on body. Spinous dorsal narrowly edged in black. Soft dorsal with basal one-half solid black penetrated by blue spots. Caudal fin basally pure yellow, outer half of fin blackish brown. Anal fin covered with blue spots as on body; basal one-third brown shading into solid black. Pelvic fins bright yellow with narrow black edge; spine and first ray edged in brown. Pectoral fin dusky brownish-black; upper ray edged in darker brown.

Stations: 10(2), 26(4), 45(1), 55(1), 58(1), 60(1), 65(1).

Habitat: Strikingly limited in distribution to the outer reef face surge channels next to the lithothamnion ridge around the entire atoll. This species comes over the reef flat at high tide to feed. It is rare in the lagoon. Natives consider this species a great delicacy and eat them raw as soon as they catch them. At low tide this species is often thrown up on the dry reef flat by particularly large waves. Dogs and natives (particularly young children) often go out at low tide looking for them and the natives catch them with their hands as the fish flop about helplessly on the reef flat.

Raroian name: KIKITO.

Acanthurus achilles (Shaw).--Distinctive colors consist of a red diamond around caudal spine and red stripes along bases of dorsal and anal fins. Life colors based on specimen from station 33: Solid black ground color. Head solid black except for a blue edge to opercular opening. Iris solid blue, edged in brownish-yellow around eye ball. Body solid black except for blue edge to operculum and narrow blue line border to red on dorsal fin; triangular patch solid red. Dorsal fin solid black except for narrow red line at base of soft dorsal; soft dorsal narrowly edged in white. Caudal fin white above, below and behind, the red vertical band suffuse with black. Anal fin narrowly edged in blue; red streak at base of soft rays. Pelvic fin with first rays bright blue, remainder of fin reddish black. Pectoral fin solid black.

In the young the body and fins are brown to yellowish brown, instead of black. The red markings are orange to yellowish-orange.

Stations: 14(1), 22(1), 33(1), 45(7), 46(1), 57(2), 58(6), 65(2), 66(9).

Habitat: This easily recognized species is particularly abundant on the shore reefs in Garue Pass and in the long partially roofed over surge channels on the outer reef flat around the atoll. It is found

in small numbers in other habitats wherever there is active coral growth, such as the lagoon coral heads and western lagoon shore reefs. While all the natives know this species as "pakurakura" they do not eat it. It is most easily obtained by means of spears.

Raroian name: PAKURAKURA.

Acanthurus elongatus (Lacépède).--Distinctive colors of solid brown without pale band through caudal peduncle. Two black spots at caudal and anal base. More than one species may be included here, since there were some slightly different color phases. Life colors based on specimens from station 58: Ground color solid brown tinged with orange over head and body. Head with faint vertical orange streaks from eye to mouth and behind to opercular edge. Iris golden-orange behind, pale black for remainder. A complete narrow circle of gold around lens on iris. Region above eye edged in yellow-orange. Groove before anterior margin of eye pale yellow. Lips black, shading to brown on snout. Jugular region pale brown, with a dark brown patch bordering lower jaw. Body solid color as described above with closely spaced narrow wavy faint blue longitudinal lines. Caudal spine brown, same color as body. Caudal peduncle posteriorly orangish. Dorsal fin orange-brown, narrowly edged in black; with approximately five longitudinal wavy pale lines. Caudal fin blackish-brown shading to black posteriorly, narrowly edged white. Anal fin same as dorsal, with two longitudinal pale lines. Base of last rays of both dorsal and anal orange. Pelvic fin edged in black, both for tip of fin and anterior edge; remainder of fin brownish-orange. Pectoral fin orangish, outer edge pale black, edge of first ray black; base orangish-black. Smaller specimens in same collection pale across caudal peduncle.

Stations: 13(1), 45(20), 57(2), 58(13), 61(3), 65(1).

Habitat: This species is moderately abundant wherever there is living coral, particularly being one of the more prominent surgeon fishes in the outer reef surge channels beyond the lithothamnion ridge. Large numbers come onto the outer reef flat to feed at high tide, especially on the east and north side of the atoll.

Raroian name: OROHEA and HAMI.

Acanthurus nigricans (Linnaeus).--Distinctive colors consist of yellow band on pectoral fin and black band behind eye and before caudal spine. Life colors based on specimens from station 60: Ground color varies from light gray to dark brown. All change to dark brown in formalin. Head evenly colored, slightly darker gray or brown on top. Iris silver to gold. Eyeball brownish black. Body slightly darker above than below. Solid black bar from behind eye to a vertical from middle of pectoral fin. Another solid black line extending forward and tapering to a point somewhat behind a vertical from appressed pelvic rays. Caudal spine covered by black skin. Teeth brown, black to greenish-brown distally, narrowly edged in black. Caudal fin white basally, shading to greyish or brownish black. Middle rays edged in hyalin, bordered by a black crescent that fades out anteriorly. Caudal

peduncle abruptly white behind spine. Anal fin same as dorsal. Pelvic fin brownish-black. Pectoral fin brownish-basally shading into black which abruptly is bordered by yellow in a vertical line. Edge of fin hyalin, the yellow shading out to hyalin. Yellow most concentrated on upper rays.

Stations: 23(1), 60(10).

Habitat: Very rare at Raroia except on outer reef flats on east side of atoll. The natives seem to know little about this species and only a few natives were certain of its name. It was seen only at the two stations at which it was collected. The natives say it is sometimes found around the lagoon coral heads.

Raroian names: MUMU AVAI and AVAI (large adults).

Acanthurus lineatus (Linnaeus).--This striking species is characterized by longitudinal blue lines bordered by black. Background color yellow posteriorly, shading to orange anteriorly. Life colors prepared at station 33: Lower side of head and body pale blue to whitish. Upper side with 10 longitudinal blue lines extending onto dorsal fin, bordered by black lines broader than the blue. Head with irregular sets of lines that have been sketched in field notes. Iris yellow bordered by dusky blue. Dorsal fin with blue lines and black borders extending on base. Remainder of fin blackish-green with longitudinal dusky black lines. Edge of fin narrowly white shading to blue; blue bordered by a black line. Caudal fin dusky black, with a blue U extending out the caudal lobes on the inner margins. Anal fin basally with an orange line that extends out the last anal rays. Remainder of fin same as dorsal except no blue lines, edge of fin the same as dorsal. Pelvic fins edged in black, narrowly bordered by yellow. Remainder of fin bright red-orange. Pectoral fin basally with three longitudinal blue lines bordered by black; remainder of fin dusky orange. Outer rays dusky black, with hyalin membranes.

Stations: 33(6), 66(9).

Habitat: Seen only at Garue Pass where it is very abundant on the shallow shore reefs. The natives know very little about this species and could recall no name for it. They do not eat it, although I know this species is sold in the central market at Papeete for food. This species can be readily speared; it does not bite on a hook.

Acanthurus sp. one.--This species is noteworthy for a white spot below the eye but no pale area on opercular margin. The dorsal and anal bases are yellow. Life colors prepared at station 61: Body and head black. Head with a white longitudinal patch under eye and a narrow white saddle behind lips that is continuous below, but not above. Iris greenish, lens narrowly edged in gold. Dorsal fin basally bright yellow, narrow for spinous and anterior part of soft dorsal, broadening to over half the length of the rays posteriorly. Spinous dorsal otherwise

black. Soft dorsal brownish black, black in center; edge of fin very narrowly white bordered by a black line. Caudal fin abruptly lighter than caudal peduncle. Lower and upper rays and outer edge of all rays grey; submarginally a yellow-orange vertical band. The fin is pale brown from band anteriorly. Anal fin same as dorsal. Pelvic fins solid black with dorsal membrane pale grey. Pectoral fin black. Upper part of base white. Caudal spine yellow. A dark blue line across snout, lower edge of operculum and below pectoral fin.

Stations: 17(2), 61(1), 66(9).

Habitat: This small species is scattered over the atoll, moderately abundant only on the lagoon shore reefs in the vicinity of Garue Pass. It is often in association with Acanthurus achilles.

Raroian name: none. It is of no importance to the natives.

Acanthurus sp. two.--This species has a broad blue base to dorsal and anal fins which is completely lost in preservation. Color notes prepared one week after preservation of specimens from station 47: Solid black on head and body except for yellow-green spot behind eye on large specimen and suffuse yellow-green before and after eye on smaller specimen. Dorsal with narrow blue before base that in life is brilliant, shading into the black of the remainder of the fin. In larger specimen there is also a blue patch on middle of last soft rays. Spinous dorsal with orange-brown irregular streaks and spots on membranes extending length of spinous fin. Caudal fin solid black. Caudal peduncle spine suffuse black, surrounded by a narrow intense black area. Anal fin largely blue, in life intense blue at base; longitudinal blue streaks near edge surrounded by blue-black and basally blue stripes extend on the membranes; edge of soft fin anteriorly edged in blue; posteriorly edged in black; submarginal area at posterior angle yellow green; anteriorly fin has orange-brown irregular streaks. Pelvic fin basally blue with orange-brown streaks out membranes. Distally orange brown streaks dusky and pelvic fin mostly black. Pectoral fin solid black.

Stations: 47(2), 60(9).

Habitat: Scattered over entire atoll around coral heads and shore reefs, but abundant only in eastern channels between islets. This is the largest species of Acanthurus at Raroia and could only be taken by spears or hook and line.

Tuamotu name: AVAI. The natives use the adults for food.

Ctenochaetus strigosus (Bennett).--This species is solid dark brown with longitudinal wavy lines. Teeth long and movable, bristle-like. Life colors prepared at station 57: Head without markings except for tiny orange spots over top of head from snout to around dorsal fin base, down to around eye and on operculum. Body with numerous narrow longitudinal wavy blue lines extending length of body. Breast solid brown,

but lines start below pectoral fin; sides of belly with blue lines. Caudal peduncle with blue lines to a vertical from caudal peduncle spine. Iris gold, ringed with blue. Dorsal fin brownish-black, narrowly edged in black to upper angle of soft dorsal. Soft dorsal with numerous straight blue lines as on body extending to posterior edge of fin. Caudal fin uniform, dark as body. Middle rays narrowly edged in hyalin, bordered by a black crescent. Anal fin same as dorsal. Pelvics same color as body. Pectoral rays brown, membranes hyalin.

Stations: 7(6), 9(1), 23(4), 28(5), 33(1), 45(3), 49(1), 57(5), 60(2), 61(24), 65(1), 66(8).

Habitat: Abundant around atoll wherever there is active coral growth, particularly on lagoon coral heads.

Tuamotu name: Actually none, although the natives refer to it by the general name "HAMI." The natives do not eat them.

Ctenochaetus sp. one.--Life colors taken at station 66: Adult solid black except for bright yellow around eye and pure white tail. Smaller specimens (95 mm. S.L.) have reddish-orange on side in region of pectoral fin. Pectoral fin yellow distally. Pelvics tinged with red and basal portion orange-red. Remarkable for its long movable bristle-teeth and deciduous scales. I was cut on the hand by the caudal spine of the largest specimen after it was speared. Immediately there was acute pain in the hand and arm. Swelling and a painful throbbing started within minutes after the cut. Within an hour my hand was so swollen I could bend the finger tips only slightly. In the meantime I had cut the wound in an attempt to flow the poison out. My arm was slightly swollen and ached clear to the shoulder when I moved it. Within two hours after the cut the wound was treated at the village. The hand remained moderately swollen for a day and completely subsided by the second day. The pain remained at its peak for a day and did not disappear until after a week had passed. I had been cut by practically all of the other surgeon fishes at Raroia, but none caused more than an immediate irritant, except for Ctenochaetus strigosus. The effects of the poison from C. strigosus on two occasions lasted for approximately 3-4 hours, but the pain was much less than in C. sp. one.

Stations: 66(3).

Habitat: This small species is characteristic of the large lagoon coral heads with abundant free-growing algae. It lives on the flat coral tops, feeding at high tide and moving down the sides of the coral heads at low tide. It never was taken by rotenone, despite repeated attempts and is very difficult to spear, being wary and extremely agile. It is moderately abundant on the shallow reefs bordering Garue Pass, in association with Zebrasoma rostratum.

Raroian name: None, although the natives are very afraid of their caudal spines and will not spear them. The natives do not use them for food.

Zebrasoma veliferum (Bloch).---Coloration same as specimens observed in Line Islands. Color notes will have to be taken from kodachrome slide taken at station 42.

Stations: 9(1), 23(1), 28(1), 42(1), 66(1).

Habitat: A typical species of lagoon coral heads and western lagoon shore reefs, although never more than ten seen at any one locality, or more than 20 on any coral head. This species was never observed where there are strong currents (e.g., Garue Pass, inter-islet channels) or on the outer reefs.

Raroian name: Well known to the natives as PAKERERO; they sometimes eat this species, but do not particularly fish for them. They are hard to spear, because they are wary and never stray far from coral growth.

Zebrasoma rostratum (Günther).---Life colors prepared at station 33: Solid black body and fins. Caudal spine white.

Stations: 33(1), 66(10).

Habitat: This species is rare at Raroia except on the lagoon shore reefs immediately south of Garue Pass. A few individuals were also seen on lagoon coral heads. It was found in association with Ctenochaetus strigosus.

Raroian name: None. The natives pay no attention to it.

Zebrasoma flavescens (Bennett).---One specimen definitely observed in the yellow phase on a large coral head in the lagoon ½ mile from Oteremu Islet. It was approximately 3½-4" long. Its coloration was solid yellow without any black. It was with the only yellow specimen of Insidiator epibulum I saw at Raroia. The life color of the specimen of Z. flavescens taken at station 23 was solid black. One other black specimen was observed on lagoon shore reefs immediately south of Garumaoa village.

Stations: 23(1).

Habitat: Only three observed during the entire summer so believed to be rare at Raroia. The natives say they seldom see this species.

Raroian name: none.

Naso tuberosus Lacépède.---Distinctive characters short flat compressed "horn" on forehead; blue spots and lines on body; long caudal filaments. Life colors prepared at station 60: General body and head color dark grayish brown. Head with a blue-black suffuse stripe forward from eye. Blue spots on head below and above eye. Lips blue-black. Body with numerous vertical blue wavy lines on middle of side.

Sides of breast and belly with numerous small blue spots extending posteriorly over middle of anal fin. No markings around spines other than blue lines and spots. Above blue lines on side larger blue spots same size as on head. Blue lines on body behind middle of anal fin extend to anal fin and curve forward ventrally. Dorsal fin solid brown, blackish brown basally. Caudal fin black basally, to blackish brown on outer one-fourth; edged in white. Anal fin brown, basally with short irregular blue lines, one for each membrane, crossing the posterior spine behind. Eye ringed with blue. Iris narrowly ringed blue, most of iris brown. Operculum edged in dark blue. Pelvic fins brown, edged in black. Pectoral fin blue-black, a blue line at base on lower rays. At station 33 it was noticed that the blue markings were brilliant blue, especially the splash marking behind the pectoral fin. Dorsal and anal edged in blue.

Stations: 33(7), 60(5).

Habitat: Very restricted at Raroia, according to the natives and my own observations, to a few lagoon coral heads approximately 2 kilometers northeast of Oneroa Village and to Garue Pass. It is very abundant in the Pass where it is taken by hook and line.

Raroian name: KARAUA; it is considered an excellent food fish by the natives, who principally take them with spears.

Naso eoume (Lesson).--Life colors taken at station 43: Overall greyish black except for white caudal fin. Dorsal fin brownish. Caudal fin black edged; middle of fin white, basally dusky. A vertical pale gray band through middle of white area. Anal fin blackish. Body with numerous vertical rows of tiny spots that tend to form into lines in some specimens.

Stations: 43(9), 45(5).

Habitat: Very restricted in distribution at Raroia, according to the natives and my own observations to a few lagoon coral heads in the region of "Makoto," 1½ miles east of Tetakaga, west side of atoll. These fishes are extremely wary, completely avoiding our attempts to kill them by rotenone, or spear them by normal means. They also do not bite on a hook. These unicorn fishes remain about 40-100' away from the sides of the coral heads, remaining motionless in schools approximately 10-20' from the surface over water approximately 80-150' deep. For reasons I cannot guess they primarily gather on the north side of the coral heads. No other fishes seem to associate with them, although occasionally they would forage for food at the base of the coral head 40-100' from the surface. Only adults were seen. The natives prize this species as the best eating of the acanthurids and have devised a way of spearing them. A twelve foot single-pointed spear is used, and a dead adult N. eoume is jiggled on the end of the spear. The native usually stays at the surface on the edge of the coral head, thrusting the dead adult at the nearest school, which will

usually be 8-20' beyond the end of the spear. Some of the school will be attracted by the unusual antics of the dead adult. When a less cautious individual gets close enough, the native will pull the spear out of the decoy with a quick jerk and in one motion lunge at the other, spearing it before it can get away. This method of spearing is very difficult and only a few natives at Raroia can do it. The natives that have mastered this method usually can spear about 4-5 in an hour.

Raroian name: TATIHI.

Naso annulatus (Quoy and Gaimard).--Life colors prepared at station 33: Solid gray in life with a faint orangish band at pectoral base and a faint orangish area around spine on caudal peduncle. Dorsal and anal fins with oblique yellowish-orange and blue streaks.

Stations: 33(1), 51(1), 67(1).

Habitat: Solitary individuals were observed in Garue Pass, and on the western lagoon coral heads and shore reefs. Not more than three were ever seen at any one time. Only large adults seen.

Raroian name: UME. The natives spear them for food.

Naso lituratus (Bloch).--Distinctive coloration orange around caudal spines, orange streak from mouth to eye and prolonged caudal filaments. Life colors taken at station 60: General color of head and body gray. Head blackish gray on top of snout and before dorsal fin. Lips solid orange. A yellow line from front of eye to behind rictus. Yellow across entire interorbital and over post and supraocular region where it is tinged with green. Iris silver, outlined in black. Eyeball lined with a horizontal blue line above iris which is bordered by black dorsally. Anterior nostril surrounded by a blue ring; narrow blue line above posterior nostril. Teeth brown. Body solid dark gray above shading into yellowish gray on body. Operculum yellowish. Anterior caudal peduncle spine with a solid orange saddle, continuous below but not quite joined on top; posterior spine with a similar-sized patch which is not continuous around peduncle above or below. Spines solid orange with blackish tips. Dorsal fin solid black; edge of spines narrowly white and an irregular white spot on each membrane near tip that becomes larger in posterior spines. Soft dorsal narrowly edged in white bordered by a fine black line, then a broad white line. Basal two-thirds of fin black. Caudal fin solid gray; middle rays edged hyalin, then narrowly grayish black. Next to this coloration is a yellow green crescent which ends before the upper and lower filaments start. Anal fin narrowly edged in white, bordered by a narrow black line; remainder of fin basally yellow green shading half way out the fin into brownish orange. Pelvic fin pale yellow-orange, anterior rays bordered in black. Pectoral fin black, white hyalin tips to the membranes, shaded with yellow, which is particularly dominant at the base of the last rays.

Stations: 7(1), 23(1), 28(5), 33(2), 42(1), 60(1), 66(1).

Habitat: Widely distributed wherever there is active coral growth on the atoll, but particularly abundant on the lagoon coral heads and west shore reefs. This is the only species of Naso that was taken by rotenone, yet not more than one or two were ever killed at a station, despite 10-25 being present in the poisoned area. The natives actively fish for this species with spears, it being a moderately important food fish. Larger young to adults commonly observed. Smaller specimens never seen.

Raroian name: TAREI.

FAMILY ZANCLIDAE

Moorish Idols

Zanclus cornutus is found in all eight habitat zones (see Ecology) but is rare in surge channels, and absent from inter-islet channels except for a few in Garue Pass. The natives do not eat them.

Zanclus cornutus (Linnaeus).--No spine present at corner of mouth. Life colors of specimen from station 61: Vertical bands black. Body yellow between bands. Head broadly black through eye superiorly to dorsal fin base. Two pale bluish-white bands extend across interorbital from eye. Lower half of snout black. Top of snout with a median black line from snout tip to interorbital. Orange saddle on top of snout bordered by black. Light region on head pure white. Caudal peduncle yellow, black line bordered by a narrow white line. Dorsal fin pale black at base anteriorly; tip of long filament white; posterior edge of fin narrowly black, submarginally white. Edge of caudal fin hyalin; broad vertical black band on fin bordered anteriorly and posteriorly by a white line. Anal fin pale black anteriorly; posterior edge black bordered submarginally by white; last rays yellow at base. Pelvic fins black. Pectoral fins hyalin, upper base orange.

Stations: 45(2), 61(1), 66(2).

Habitat: Moderately common at Raroia but extremely difficult to obtain. This species is widely scattered throughout lagoon on shore reefs and around coral heads. It is most abundant on western shore reefs. Fewer individuals live in pot holes and roofed over surge troughs on the outer reef flat and in Garue Pass. In the lagoon it is often in association with Heniochus.

Raroian name: PANAPANA.

FAMILY SCORPAENIDAE

Rock Fishes

At least ten species of the family Scorpaenidae were tkane at Raroia, but identification of the smaller specimens was so confusing that only part of the collections are recorded. The family is most abundant on the outer reef flat, particularly in sea urchin holes behind the coralline ridge. To a lesser extent the group is common in surge channels and on lagoon shore reefs, but is very rarely seen on lagoon coral heads.

The natives fear all of them as being venemous, but actually only Pterois, Scorpaenodes, Scorpaenopsis gibbosus and Synanceja appear to really belong in this category. The natives do not eat any of them.

Pterois volitans (Linnaeus).--Life colors of specimen from station 61: Head and body with brown vertical bands separated by white or reddish-white narrow interspaces. Head dark brown above, dorsally covered with reddish-white narrow lines. Supraocular flap striped black and white. Snout white except for two brown spots bordering upper jaw. White flap at side of mouth distally and posteriorly edged with orange. Lower preopercular edge with two orange cirri with a white line down the center. Iris black above and below, otherwise golden to brownish-golden. Underside of head white. Breast white, crossed by two pale lines. Belly white except for bands continuous across ventor. Spinous dorsal membranes pale brown; dorsal spines crossed by broad black and reddish-white bands. Soft dorsal hyalin except for approximately five black cross bands on rays. Caudal fin hyalin except for 5-6 vertical series of spots as on soft dorsal. Anal fin similar to caudal, with white dots more prominent. Pelvic fins with reddish-white rays; membranes solid pale black. Pectoral fins with rays reddish-white; basal section of rays with three black to brown bands; outer portion of membranes with large round black spots, not more than two per membrane.

Stations: 10(1), 16(1), 22(1), 44(1), 61(1), 66(2).

Habitat: Outer reef flat under rocks. Observed nowhere else at Raroia.

Raroian name: TATARAIHAU.

Scorpaenodes parvipinnis (Garrett).--Dorsal spines very short. Scales extending onto soft dorsal and anal fins. Head and body coloration mottled like coralline algae. Life colors of specimen from station 17: Ground color light brown to lavender and pink. Head with dark brown stripes. Iris intricately striped with orangish-red and brown. Eyeball yellow bordered by greenish-brown. Body with a broad vertical brown band that is bordered above and below by pink markings. Caudal peduncle with a dark brown vertical stripe. Soft dorsal, anal and caudal fins with yellow spots. Caudal fin bright yellow. Pelvic

fins dark brown with pink and yellow markings. Pectoral fins crossed by a vertical brownish-purple stripe near base; remainder of fins yellow with a bright yellow spot.

Stations: 17(1).

Habitat: Observed in sea urchin holes behind coralline ridge on outer reef flat.

Raroian name: none.

Scorpaenodes sp. one.--Thirteen dorsal spines present. Two black spots on soft dorsal. Long flap on side of upper jaw. Life colors of specimen from station 61: General color bright orange with brownish to jet black markings. Head bright orange on interorbital region, tip of snout and above upper lip. Jaw flap striped black and orange. Iris marked with 6 broad black bands that extend almost to lens border. Lens border narrowly ringed in black crossed by numerous brown lines. Top of snout dusky black. Side of operculum also dusky black. Lower half of head orange mottled with dusky black. Lips dusky orange. Body crossed by five broad suffuse vertical bands; various scales pure black to orangish-brown; interspaces orange, except white between last two vertical bands. Spinous dorsal basally orange where body interspaces continue on fin; membranes bluish-gray, distally with one or two longitudinal white lines; spines distally crossed by three or four black bands. Soft dorsal with two brilliant black spots surrounded by orange and black rings; basal region of soft dorsal scaled and colored like body. Caudal fin membranes hyalin; rays crossed by approximately six black spots. Anal fin edge white; middle of fin crossed by a white longitudinal line; basal region of fin gray, darker anteriorly. Outer region of fin with approximately six suffuse black spots. Pelvic fins dusky black, edged in white, and with a basal white spot posteriorly; middle of fin shades to white on posterior rays. Pectoral fin brilliantly marked with four vertical black lines alternating with orange; lower simple rays crossed with white and black bands; base of fin orange-brown.

Stations: 10(1), 61(1).

Habitat: Known only from outer reef flat under rocks.

Raroian name: TATARAIHAU.

Scorpaenopsia gibbosus (Schneider).--Large pit present under eye. Head and body mottled grey and white. A vertical grey band present on caudal fin. Two dark bands extend across pectoral fin.

Stations: 12(1).

Habitat: Only one specimen noted from shore reefs next to Garumaoa Village in lagoon. Natives say the dorsal spines are poisonous.

Raroian name: PUGA PUGA VEVE.

Scorpaenopsis sp. one.--Lateral line with 35 scales. Palatine teeth absent. No pit below eye. Ground color mottled overall, blending with coralline algae of coralline ridge. Upper region of back green. Fins reddish. Head mottled with grey, lavender, green, red and orange. No distinct bands on body. All fins also mottled.

Stations: 7(2), 8(2), 9(2), 17(2), 61(3).

Habitat: Hides in holes in coral along reef flat and in lagoon.

Raroian name: none.

Scorpaenopsis sp. two.--Palatine teeth absent. Thirty lateral line scales. Pit indistinct below eye.

Stations: 17(2).

Habitat: Noted from sea urchin holes behind coralline ridge on reef flat.

Raroian name: none.

Scorpaenopsis sp. three.--Body with broad light brown vertical band. Brown streaks radiating from eye. Caudal peduncle crossed by a vertical brown band. Life colors of specimen from station 58: Ground color light brown. Head pale whitish-brown, somewhat darker on top of head. Eye with four dusky black lines radiating from its lower margin across lips and suborbital region. First three lines ending on upper jaw. Mid-dorsal line with a black spot on snout, a brown spot anteriorly on interorbital, and three suffuse vertical lines across posterior region of interorbital. Occiput with a suffuse vertical line and spots on nape. Body with two suffuse superior bands ending above lateral-line. A brownish black spot is present behind upper angle of operculum. Most of body covered with a single broad brown vertical band that extends to belly; posteriorly it ends below last soft dorsal rays at end of anal fin base. Base of caudal fin crossed by an irregular vertical brown band. Spinous dorsal coloration similar to body, with brown spots on the spines. Soft dorsal reddish-brown basally, with six series of oblique brown spots on rays; membranes hyalin at tip. Caudal fin regularly spotted with brown on rays; membranes hyalin. Anal fin basally red, edged in brown; middle of fin with eight brown spots; edged hyalin. Pelvic fins with a few scattered brown spots, pale red to hyalin at tip. Pectoral fins with 2-3 vertical rows of brown spots; base yellow; membranes hyalin.

Stations: 45(6), 58(1).

Habitat: Common in surge channels.

Raroian name: none.

Scorpaenopsis sp. four.--Suborbital spine extending down over side of upper jaw. Head and body covered with numerous black spots. Life colors of specimens from station 58: Ground color brownish-grey. Body covered by brownish-black to black spots, irregularly arranged so that there are no lines or bands. Belly white except for a few brown spots. Head covered by tiny black spots. Iris gold, outlined with an orange-red ring. Dorsal fin mottled like body, edged in orange-black. Soft dorsal shading to hyalin distally. Caudal fin with approximately four vertical series of brownish-black spots on rays and membranes; edge of fin pale red. Anal fin with scattered brownish-black spots, tip of fin hyalin. Pelvic fins with suffuse brown spots, remainder of fin hyalin. Pectoral fins with six series of brown spots following the contour of the fin.

Stations: 45(2), 58(3).

Habitat: Observed in surge channels.

Raroian name: none.

Taenianotus triacanthus Lacépède.--One specimen solid black. The other specimen taken at station 66 was mottled like coralline algae.

Stations: 66(1).

Habitat: Two specimens collected from under rocks on outer reef flat and on shore reef in Garue Pass.

Raroian name: none.

Synanceja verrucosa Schneider.--Grey in color. Body as broad as deep. Head broader than deep.

Stations: 12(2).

Habitat: Observed only in the lagoon on the western shore reef flat. This species hides in holes under rocks and in the coral during the day; at night it comes over the flats near shore to feed. They are completely unafraid and refuse to move, even when poked. When disturbed they remain perfectly stiff and can be pushed or hit without making any movement. However, when they have had enough, they make a slow deliberate retreat.

Raroian name: PUGA PUGA.

FAMILY CARACANTHIDAE

This family is one of the most abundant in the cracks and holes of the outer reef flat, but is restricted to very shallow water between the inner

edge of the coralline ridge and inner beachrock tide pools. It is found in close association with Paragobiodon in this reef flat region. Occasionally, specimens are taken elsewhere around the atoll on lagoon shore reefs or on lagoon coral heads. It is rarely seen in a habitat over two feet deep. The natives have no name for this group, being too small to be of any consequence to them. Only two species seen at Raroia.

Caracanthus unipinna (Gray).--Dorsal fins fully united without a notch. Life colors of specimens from station 57: General color grey to blackish-brown, head and breast lighter. Dorsal and anal fins dark grey at base, shading to light grey distally. Caudal fin grey, somewhat lighter at tip. Anal and pectoral fins light grey.

Stations: 17(1), 57(3), 58(3).

Habitat: As described under the family.

Caracanthus maculatus (Gray).--Dorsal fins separated by notch. Life colors of specimens from station 57: General color of head and body grey, fading to greyish-white below. Spots on head and body reddish-brown anteriorly to brown posteriorly. Lower side of head and body without spots. Iris gold around lens to black distally. All fins pale at base, shading to dusky black at tip, except caudal which is pale black with a hyalin edge. Pectoral fin with reddish-brown spots on base and lower part of fin.

Stations: 17(2), 57(4), 58(1), 61(1).

Habitat: As described under family.

FAMILY BOTHIDAE

Flat Fishes

Only one species of flatfish was seen at Raroia, and the natives said there was only this one there.

Bothus pantherinus (Rüppell).--Eyes on left side. Life colors of specimens from station 58: Extremely variable in color but with stable pattern. Ground color ranging from brownish-white to brown, gray or black. Head and body covered with irregularly outlined circles with pale centers. Head orange to reddish-brown between eyes. Numerous small blue spots around eyes. Fins mottled like body with smaller circles. Edge of dorsal and anal fins hyalin. Pectoral fin with long filamentous upper rays in larger specimens. Three black spots on body on horizontal line from eye. Anteriormost black spot large, approximately same diameter as interorbital width, situated immediately above pectoral base. Second black spot approximately as large as eye, situated equidistant between first spot and end of dorsal fin. Third black spot often faint, near caudal peduncle below end of dorsal fin.

Stations: 10(1), 14(6), 16(1), 20(2), 21(1), 22(6), 23(1), 28(2), 31(1), 45(2), 47(1), 58(4), 65(1).

Habitat: Abundant on the outer reef flat around the atoll and to a lesser extent on the gravel and sand inter-islet channels. Rare in the lagoon, but occasionally occurring on the sandy tops of lagoon coral heads and shore reefs.

FAMILY BALISTIDAE

Trigger Fishes

Eight species of trigger fishes were taken and I doubt if more than one or two other species occur at Raroia. The natives asserted that we had collected all the different kinds occurring at this atoll. All species except those of the genus Balistapus are abundant at Garue Pass and immediate vicinity; they also abound in deeper water on the outside deeper reef shelf, but are rare in the lagoon. The genus Balistapus is very abundant on the outer reef flat around the atoll, and to a lesser extent is found wherever there is coral in the lagoon. Almost all the trigger fishes make grunting sounds when caught, the genus Balistapus making the loudest noise. All species, except those of the genus Balistapus, take a hook and are eaten by the natives.

Balistes vidua Richardson.--Distinctive coloration of caudal fin rose-red. Pectoral fin yellow. White dorsal and anal fin edged in black. Life colors prepared at station 33: Head and body dark brownish-black overall. Iris dusky golden. Lips dark brown. Teeth white. Eyeball jet black. Spinous dorsal brownish-black. Dorsal and anal fins edged anteriorly and distally by narrow black band. Remainder of fin pure white. Caudal fin narrowly edged dorsally and ventrally by black. Caudal fin rose-red, somewhat fading at posterior edge. Base of fin and posterior part of caudal peduncle white.

Stations: 33(1).

Habitat: Only one specimen in Garue Pass taken. The natives say it is fairly common in the Pass and along the outer deeper coral shelf on the west side of the atoll. None seen other than the example taken.

Raroian name: POPOGA.

Balistes undulatus Mungo Park.--Distinctive coloration of black around caudal peduncle spines. Orange streak extending from mouth to below pectoral fin. Life colors taken at station 33: Stripes on body bright orange, those around mouth brightest. Lower jaw with bright orange around middle. Tip of upper jaw orange. Otherwise lips blackish-brown. Iris pale green, eyeball brown. Lens narrowly ringed in gold; radiating lines from lens; on pale green eight suffuse orange lines; on brown

10 blue lines bordered by black lines. General color pattern of numerous orange lines: 6 lines from eye (counting one above and below) across interorbital; 16 lines from orange spots below to middle dorsal rays. Spinous dorsal brown, black at tip of first membrane. Soft dorsal and anal with orange longitudinal line at base. All rays pale bluish gray at base, remainder orange. Membranes hyalin. Caudal fin with outer rays orange, middle rays yellow. Caudal peduncle with vertical orange lines. Pectoral fin with orange rays, pale black at tips, membranes hyalin.

Stations: 33(3).

Habitat: Collected only in Garue Pass. An adult was observed on a lagoon shore reef on the northeast side of the atoll.

Raroian name: KOKIRI KARAVA.

Balistes fuscus Schneider.--Distinctive colors consist of black fins with yellow-orange edges (except spinous dorsal which is solid black). Life colors prepared from an example taken at station 33. General color dark grey. Iris greenish gold. First dorsal dusky black. Dorsal and anal black to brownish black, fin edge yellow-orange. When viewed through light dorsal has a basal pale brown longitudinal line. Lower half of fin has series of four spots on each membrane in a vertical line that tend to form into lines posteriorly. Anal fin similar. Caudal fin black to dark brown, the posterior edge of the middle rays are yellow-orange to hyalin at tips. Pectoral fin black with pale brownish yellow margin.

Stations: 33(2).

Habitat: Scattered individuals seen around lagoon coral heads; it is most abundant in Garue Pass.

Raroian name: KUTARO.

Balistes capistratus Shaw.--Distinctive coloration of solid brown overall except lower lip orange, with a pale brown line above and below lips. Numerous rows of small spines on posterior part of body. Life colors taken at station 33: Lips grayish purple. Posterior edge of lower lip orange. Pale line around lips brown, slightly orange below. Iris brown, somewhat golden anteriorly. Pectoral fin green, outer edge abruptly dusky black.

Stations: 33(2).

Habitat: Seen and taken only in Garue Pass. The natives very rarely see this fish and know little about it.

Raroian name: none, other than the general trigger fish name of KOKIRI.

Balistes sp. one.--Characterized by seven horizontal rows of spines on caudal peduncle. All fins with black band near edge. Black streak around eye. Life colors of a specimen from station 60: General color slate-grey with the white in the caudal showing up as the most distinctive marking in life. Head with black streaks bordering upper jaw, and medially on snout through eye, gill opening, onto base of pectoral fin. Lower lip brown. Eye distinctly marked with numerous black lines. Lens golden green with 6 broad lines radiating from lens. Eyeball dark grey with 20 wavy black lines radiating from cornea. Spinous dorsal dusky black. Soft dorsal and anal white with a broad black band near tip. Last rays dusky black at base. Caudal fin edged with a broad black band. Upper and lower long rays black; entire basal area dusky black; middle of caudal fin white. Pectoral fin white, a broad black band near tip of fin. Edge of pectoral fin white.

Stations: 15(1), 27(1), 33(4), 60(1).

Habitat: This is the largest trigger fish at Raroia, and individuals are found in Garue Pass, in inter-islet channels with swift moving water (at high tide) and along the outer deeper coral shelf on the west side of the atoll. The natives spear it for food and occastionally take it on hook and line.

Raroian name: KOKIRI PAGO.

Balistapus rectangulus (Schneider).--Distinctive coloration of black diamond on tail and black oblique stripe on body. Life colors will have to be prepared from kodachrome slides taken at stations 31 and 45.

Stations: 16(1), 22(7), 31(1), 45(4).

Habitat: This species is almost entirely restricted to the outer reef flat around the atoll on which it feeds at high tide. At low tide it hides under rocks or in holes in the dead coral. It is about one-third as abundant as Balistapus aculeatus, and much more restricted in distribution than the latter species. The natives take them unintentionally on hook and line but do not eat them.

Raroian name: none, other than the general trigger fish name KOKIRI.

Balistapus aculeatus (Linnaeus).--Distinctive coloration consists of oblique vertical stripes without black patch on caudal peduncle or black oblique band as in B. rectangulus.

Stations: 10(1), 14(4), 22(8), 24(1), 31(19), 45(3), 52(1), 60(2).

Habitat: A dominant species of the outer reef flat around the atoll. Scattered individuals occur around all the coral heads in the lagoon and on the lagoon shore reefs. This is a strictly shallow water form.

Raroian name: KOKIRI HORATAHORA.

Melichthys buniva (Lacépède).--Distinctive colors blue lines on dorsal and anal fin bases. Pectoral fin black. Life color notes prepared from specimens taken at station 33: Solid black over all. A narrow brilliant blue line along base of dorsal and anal fins. A thin blue line is submarginal to middle caudal rays. Iris golden black. Lines across interorbital faint. Teeth white, tinged with purplish brown along middle. Pectoral fin solid black.

Stations: 33(4).

Habitat: This species is fairly abundant in Garue Pass and along the outer deeper coral shelf on the west side of the atoll.

Raroian name: HOPUPU.

FAMILY MONACANTHIDAE

File Fishes

Three species were noted from Raroia and probably several other species occur there in deeper water. This family prefers hiding places under rocks and coral on the outer reef flat. It is expected that it is also common on the coralliferous outer bench. It is uncommon in the lagoon, although the natives say they are abundant in Garue Pass.

The natives do not eat them and they are usually referred to as KOKIRE, the general Raroian term for trigger fishes. The application of the name KOKIRE KARAVA to two of the monacanthids and not to the very similar third species seems strange. This discrepancy was checked with several natives and appears to be correct.

Cantherines pardalis (Rüppell).--Head, body and caudal fin solid dark brown. Dorsal, anal and pectoral fins with brown rays and pale brown membranes. Caudal fin brownish black, distally shading darker than body. Lips pale brown. Teeth pure white. Iris blue. Eyeball tan.

Stations: 27(1).

Habitat: Observed on outer reef flat of west side of atoll.

Raroian name: KOKIRE KARAVA.

Cantherines sp. one.--Life colors of specimen from station 46: Head, body and all but posterior margin of caudal fin uniform slate grey without spots or markings. Dorsal, anal and pectoral fins completely hyalin. Posterior edge of caudal except upper and lower lobes white (not hyalin). Iris light green. Lips light grey. Life colors of specimen from station 58: Dorsal, anal and pectoral fins pale yellow. Posterior

region of caudal fin yellowish before hyalin edge. Iris yellowish-green. Faint yellowish lines from eye extending obliquely forward. Numerous faint yellow spots from snout.

Stations: 15(1), 16(1), 26(1), 45(5), 46(1), 58(1).

Habitat: A few individuals noted in lagoon but primarily observed in holes in the coral and under rocks on the outer reef flat.

Raroian name: KOKIRE.

Cantherines sp. two.--Solid brown with orange fins; four forward projecting scales on caudal peduncle. Life colors of specimen from station 45: Body solid brown. Lips pale yellowish-brown. Iris pale blue ringed with orange. Dorsal, anal and pectoral fins pale orange. Caudal fin brown, posterior edge orange. Caudal peduncle spines orange.

Stations: 33(1), 45(1).

Habitat: Noted hiding in holes on shore reefs in Garue Pass and under rocks on outer reef flat.

Raroian name: KOKIRE KARAVA.

FAMILY TETRAODONTIDAE

Puffer Fishes

Seven species of puffer fishes occur at Raroia and apparently all species existing there were taken. The genus Tetraodon is most common on the outer reef flat and to a less extent in the inter-islet channels. The genus Canthigaster is mostly confined to lagoon western shore reefs and inter-islet channels. Occasional individuals were noted on lagoon coral heads. The family Canthigasteridae is included under the family Tetraodontidae in the field notes and has not been separated in this report.

Tetraodon meleagris Schneider.--Solid black with light blue spots on head, body and fins. Edges of fins hyalin. Life colors of specimen from station 52: Edge of pectoral fin bright yellow-orange. Edge of dorsal fin light yellow to hyalin. Edge of caudal narrowly white, remainder black with light blue spots as on other fins. Anal fin edge yellow-orange. Teeth white.

Stations: 10(1), 17(1), 18(1), 22(8), 31(1), 33(1), 45(3), 47(1), 52(1), 60(1).

Habitat: Common on outer reef flat particularly of west side of atoll. At low tide they hide among coral and rocks and come out to feed at high tide.

Raroian name: KOPARIPARI MORORI.

Tetraodon regani Günther.--Life colors of specimen from station 52: Ground color black with numerous light blue spots over head, body and caudal fin. Dorsal fin pale yellow-orange, with obscure pale black reticulations; edge of fin hyalin. Anal fin similar to dorsal. Caudal fin with spots and black background almost out to edge of fin.

Stations: 11(1), 19(1), 33(2), 52(1).

Habitat: Not as common as Tetraodon meleagris; almost entirely confined to inter-islet channels. Occasionally noted on outer reef flat.

Raroian name: KOPARIPARI.

Tetraodon sp. one.--Head and body yellow above to white below. Vertical fins pale yellow. Pectoral fins orangish-yellow with brown streaks between rays. Left side with a brown spot above gill opening. Above notes of specimen from station 22.

Stations: 22(1).

Habitat: Only one observed and captured on outer reef flat, west side of atoll.

Raroian name: KOPARIPARI.

Canthigaster cinctus (Richardson).--Top of head and body crossed by four vertical black bands.

Stations: 9(1), 23(1).

Habitat: Moderately uncommon at Raroia. Noted only on shore reefs, west side of lagoon, in region of Garumaoa Village.

Raroian name: HUE TETE.

Canthigaster solandri (Richardson).--Head, body and caudal fin covered with blue spots edged in black. Ground color brown shading to whitish below. Throat yellow. Blue lines edged in black radiating from eye. Eyeball green. Iris ringed with three metallic orange and blue bands. Two of the lines radiating from the eye cross the interorbital.

Stations: 9(5), 11(1), 12(1), 25(1), 57(1), 58(1).

Habitat: Moderately common at Raroia; definitely the most abundant species of Canthigaster at this atoll. It was mainly noted in the western inter-islet channels and to a lesser extent in the lagoon on the west shore reefs and coral heads. One specimen was taken on the outer reef flat.

Raroian name: HUE TETE.

Canthigaster bennettii (Bleeker).--Ground color greenish-brown. Snout and belly with indistinct yellow spots. Most prominent marking on body is a black blotch at the base of the dorsal fin. A broad yellow-orange band extends from behind pectoral fin to lower region of caudal peduncle. Blue spots present on upper side of caudal peduncle. Blue lines radiating from eye but none extending across snout or interorbital.

Stations: 9(12), 12(2), 23(1).

Habitat: Uncommon at Raroia. Noted only on lagoon shore reefs in vicinity of Garumaoa Village.

Raroian name: HUE TETE.

Canthigaster janthinopterus (Bleeker).--Sides of body brown with large blue spots. These spots become larger on belly and underside of head until there are brown reticulations instead of spots. Life colors of specimen from station 66: Top of head with suffuse markings. Two longitudinal brown stripes on middle of interorbital. Head with brown reticulations (somewhat orange around eye) that become narrower ventrally. Between reticulations pale blue. Iris ringed with orange around lens; remainder blue-green. Body gradually changes from reticulations anteriorly to spots on a brown background dorsally and posteriorly. Dorsal base black. Fins hyalin with pale black rays.

Stations: 66(1).

Habitat: Several specimens noted on shore reefs in Garue Pass.

Raroian name: HUE TETE.

FAMILY DIODONTIDAE

Porcupine Fishes

Apparently only one species occurs at Raroia, but there was some disagreement among the natives on this point. The natives relish it for food and prefer to cook it whole in a fire, spines and all. Then they peel off the skin, and eat the flesh. Diodon is not poisonous at Raroia, nor did the natives know it to be poisonous on the neighboring islands.

Diodon hystrix Linnaeus.--Life colors of specimens from station 47: general color light below, white shading to dusky black above in one specimen and to brown above, in the other. Spots in both specimens solid black.

Stations: 47(2), 60(1).

Habitat: This species prefers the broad sand flats at the southern end of the atoll and usually occur in pairs. They are uncommon at Raroia.

Raroian name: TOTARA.

FAMILY OSTRACIIDAE

Box Fishes

Two species were collected at Raroia and I doubt that others occur there, except natives say the genus Lactoria occurs in the lagoon. Box fishes are moderately uncommon at Raroia and all examples were seen deep in holes in the coral or under rocks. Rotenone did not kill them. The majority of the field records note them from inter-islet channels. The natives do not use them for food, but do not consider them poisonous.

Ostracion sebae Bleeker.--General color black with orange spots and markings. Life colors of specimen from station 52: Head and body solid black, grey beneath eye to a vertical from pectoral fin base. Large blotch of orange on interorbital and superior orbital socket. Iris black, with large orange spots, superiorly metallic blue spots between orange markings. Body with orange spots on side, a few on bottom of carapace near lateral angle in region of pectoral fin and anal fin. The orange spots tend to become irregularly elongate near edge of upper carapace angle. Top of body with small evenly spaced white spots from posterior margin of eye to end of dorsal fin. Caudal peduncle with large irregular orange spots that tend to join together. Dorsal fin with black rays, hyalin membranes. Caudal fin black except for a crescent shaped posterior hyalin area. Anal fin with brownish-black rays and hyalin membranes. Pectoral fin same as anal.

Stations: 52(1).

Habitat: Only one specimen observed and collected in inter-islet channel north of Garue Pass.

Raroian name: TUTUKE.

Ostracion lentiginosus Schneider.--General color brown with yellow fins. Blue spots on body ringed in black. Life colors of specimen from station 51: General color brown to yellowish-brown ventrally and posteriorly. Head with scattered black spots, particularly around orbital border. Iris silver. Body with small white to bluish-white spots surrounded by a black ring. Blue spots confined to sides and top of carapace. Bottom of carapace in head region with black spots, otherwise carapace bottom markless, except for a spot on each side before anus. Black spot present on dorsal fin base. Caudal peduncle uniform yellowish-brown. Fins yellow-orange except for dusky irregular black stripe in upper posterior section of tail; tips of outer caudal rays dusky black.

Stations: 36(1), 38(1), 42(1), 51(1), 60(2).

Habitat: Moderately common at Raroia. Apparently confined to lagoon shore reefs, inter-islet channels and occasionally on outer reef flat.

Raroian name: TUTUKE.

FAMILY ANTENNARIIDAE

Angler Fishes

Two antennariids (apparently different species) taken at Raroia under rocks in channels between islets. The natives seldom see this species and confuse it with Synanceja, calling it PUGA PUGA.

Antennarius sp. one.--This species has a long slender ilicium. Caudal fin with vertical black stripes. Head and body mottled white, grey, green and black without spots, blending with the gravel and dead coral.

Stations: 22(1).

Habitat: This frogfish was found among dead coral fragments in shallow water (6" deep) under a rock in an inter-islet channel. It remained perfectly still when disturbed, and blended perfectly with its background.

CHECK LIST OF THE ISLANDS OF THE TUAMOTU ARCHIPELAGO

While attempting to prepare a bibliography of all known fishes collected in the Tuamotus it became apparent that there was considerable confusion concerning the names of the islands and island groups. When we attempted to check the standard sources we discovered that none were completely reliable, and many were filled with confusing errors. As a result we found it necessary to prepare a new list based on H. O. chart number 0077 (January 27, 1951) and H. O. Gazetteer number 7 (1944). Brigham (1900), Wilkes (1845), Picquenot (1900), and Freeman (1951) are the principal sources utilized.

In the course of compiling this check list we learned that the confusion was greatest east of the cannibal line (see Wilkes, 1845, chart of Paumotu Group prepared in 1839) northwest to southeast through the center of the Tuamotus. The probable reason for this situation is because few expeditions have entered that area of the Tuamotus and hostility of the natives in the nineteenth century prevented landing parties from examining most of the islands.

I. Island Groups.

Actaeon Is. (21 20 S 136 30 W) = Amphitrite Is.:

Maturei-Vavao (Atoll, 21 22 S 136 23 W) = Melbourne, Acteon I. (Wilkes Exped.), Estancelin.

Tenararo (Atoll, 21 20 S 136 43 W) = Acteon I. (Wilkes Exped.), Bedford.

Tenarunga (Island, 21 20 S 136 30 W) = Minto, Acteon I. (Wilkes Exped.).

Vahanga (Atoll, 21 20 S 136 40 W) = Bedford, Vehanga (Brigham).

Disappointment Is. (14 08 S 141 20 W) = Iles du Desappointement, Disappointment Is. of Byron:

Napuka (Atoll, 14 08 S 141 14 W) = Wytoohee (Wilkes Exped.).

Tepoto (14 05 S 141 24 W) = Otooho (Wilkes Exped.), Tetopoto.

Duke of Gloucester Is. (20 40 S 143 20 W):

Anuanuraro (Atoll, 20 25 S 143 33 W) = Archangel (of Quiros), Anu-anuraro, Anu-Anuraro, San Miguel Archangel, Heretutea, Heretua (Wilkes Exped.).

Anuanurunga (Atoll, 20 38 S 143 19 W) = Teku (Wilkes Exped.), Four Crowns (of Quiros), Quarto Coronados.

Nukutipipi (Atoll, 20 42 S 143 05 W) = Margaret, Nukutavake (lapsus, Brigham chart).

Gambier Is. (23 10 S 135 00 W) = Peard:

Agakauitai (Island, 23 10 S 135 01 W) = Agakanitai (Brigham).

Akamaru (Island, 23 12 S 134 54 W) = Wainwright.

Aukena (Island, 23 08 S 134 54 W) = Elson.

Kamaka (Island, 23 15 S 134 57 W) = Collie, Collis.

Makapu (Islet, 23 12 S 134 55 W).

Makaroa (Island, 23 14 S 134 58 W) = Marsh.

Mangareva (Island, 23 07 S 134 58 W) = Peard, Manga Reva.

Manui (Island, 23 14 S 134 56 W).

Taravai (Island, 23 09 S 135 02 W) = Belcher.

King Georges Gp. (14 35 S 145 00 W) = Iles du Roi George:

Takapoto (Atoll, 14 38 S 145 11 W) = Oura (of Cook), Taputa, Ura.

Takaroa (Atoll, 14 27 S 144 58 W) = Takoroa, Tiokea.

Palliser Is. (15 31 S 146 38 W) = Shadelyk, Pernicious:

Apataki (Atoll, 15 25 S 146 20 W) = Hegemeister.

Arutua (Atoll, 15 18 S 146 44 W) = Rurick (of Kotzebue).

Kaukura (Atoll, 15 43 S 146 40 W) = Aura.

Toau (Atoll, 15 54 S 146 01 W) = Elizabeth.

Sea Gull Group (16 44 S 144 15 W) = Raeffsky Is.:

Hiti (Atoll, 16 44 S 144 08 W) = Eliza, Tipotu or Bacon (Wilkes Exped.).

Tepoto (Atoll, 16 49 S 144 17 W) = Eliza (of Mauruc), Ofiti, Ohiti or Clute (Wilkes Exped.).

Tuanake (Atoll, 16 41 S 144 14 W) = Reid, Tuinaki, or Ried (Wilkes Exped.).

Two Groups (18 07 S 142 10 W) = Manaka:

Marokau (Atoll, 18 07 S 142 13 W) = Dauahaida, Dawhaida (Wilkes Exped.). [North Atoll of Manaka].

Ravahere (Atoll, 18 14 S 142 10 W) = Dawhaida, Manaka (Wilkes Exped.). [South Atoll of Manaka].

Vairaatea (19 20 S 139 20 W) = Egmont, Tatakoto (lapsus, Wilkes Exped.):

Pukararo (Atoll, 19 20 S 139 20 W) = Tres Cootiers, Tatakotu (lapsus, Wilkes Exped.), Tres Cocotiers (du Mauruc).

Pukarunga (Atoll, 19 20 S 139 20 W) = Tatakoto (lapsus, Wilkes).

II. Islands not in Groups.

Ahe (Island, 14 30 S 146 20 W) = Peacock, Ahii.

Ahunui (Atoll, 19 40 S 140 25 W) = Byam Martin, Nganaiti (Wilkes Exped.), Pinaki or Whitsunday (lapsus, Brigham), Nganati (Brigham), Ahuni (H. O. Gazetteer).

Aki-Aki (Atoll, 18 30 S 139 13 W) = Thrum Cap, Lancier, Vahitahi (lapsus Brigham, descr.), Les Lanciers (Bougainville), Pukerua (lapsus, Wilkes Exped.).

Amanu (Atoll, 17 50 S 140 45 W) = Moller.

Anaa (Atoll, 17 25 S 145 32 W) = Chain I.

Angatau (Atoll, 15 50 S 140 50 W) = Arakchev, Arakcheef, Ahangatiu, or Arackchuff (Wilkes Exped.).

Aratika (Atoll, 15 32 S 145 31 W) = Karlsholl, Carlshov, Carlshoff, Karlshoff.

Encarnacion (Approx. 24 44 S 136 40 W) = Wilkes Exped.

Faaite (Atoll, 16 45 S 145 13 W) = Mylardowitich, Faiti.

Fakarava (Atoll, 16 18 S 145 36 W) = Wittgenstein.

Fangahina (Atoll, 15 59 S 140 07 W) = Fakahina, Fakaina, Akahaina, Predpriaetige (Wilkes Exped.), Predpriatie.

Fangatau (Atoll, 22 15 S 138 45 W) = Cockburn, Fangataufa, Ahunui (lapsus, H. O. Gazetteer and Brigham).

Hao (Atoll, 18 13 S 140 54 W) = Bow, La Harpe, Harp, Hau.

Haraiki (Atoll, 17 30 S 143 30 W) = Croker, St. Quentin, Heraiki.

Hereheretue (Atoll, 19 50 S 145 00 W) = St. Paul, San Pablo (Wilkes Exped.), Tematangi (lapsus, Brigham descr.)

Hikueru (Atoll, 17 36 S 142 40 W) = Melville, Bird, Tekukota (lapsus, Wilkes Exped.).

Katiu (Atoll, 16 26 S 144 21 W) = Saken.

Kauehi (Atoll, 15 51 S 145 10 W) = Vincennes, Kaueh, Kawehe.

Makatea (Island, 15 52 S 148 13 W) = Metia, Aurora, Dageraad.

Makemo (Atoll, 16 37 S 143 41 W) = Phillips, Makima, Makemu (Wilkes Exped.), Koutousoff (of Bellingshausen).

Manihi (Atoll, 14 20 S 145 59 W) = Wilsons, Waterlandt (of Schouten and Lemaire), Oahe, Manhii (Wilkes Exped.).

Manuhangi (Atoll, 19 11 S 141 16 W) = Cumberland, Manuwangi (Wilkes Exped.), Mahuagi.

Maria (Atoll, 22 00 S 136 10 W) = Moerenhout, Maria Reef (Wilkes Exped.).

Matahiva (Atoll, 14 50 S 148 40 W) = Lazareff, Mataiwa (Wilkes Exped.).

Minerva (Reef, 22 40 S 133 30 W) = Ebrilles, Bertero, Berbero.

Morane (Atoll, 23 00 S 137 10 W) = Cadmus, (Wilkes Exped.).

Motutunga (Atoll, 17 05 S 144 22 W) = Motu Tunga, Adventure.

Mururoa (Atoll, 21 50 S 138 50 W) = Matilda, Osnaburgh.

N. Marutea (Atoll, 17 00 S 143 11 W) = Furneaux, Marutea (Wilkes Exped.).

Nengo Nengo (Atoll, 18 46 S 141 48 W) = Pr. William Henry, Nargohengo, L'Ostange, Lastang (Wilkes Exped.).

Niau (Atoll, 16 10 S 146 21 W) = Greig.

Nihiru (Atoll, 16 43 S 142 50 W) = Nehiru or Niori (Wilkes Exped.), Negeri, Nigeri, Niheri.

Nukutavake (Island, 19 40 S, 138 42 W) = Queen Charlotte, Nukutapipi (lapsus, Brigham chart), Vahitahi (lapsus, Brigham descr.), Akiaki (lapsus, Wilkes Exped.).

Paraoa (Atoll, 19 08 S 140 40 W) = Hairi, Gloucester.

Pinaki (Atoll, 19 20 S 138 40 W) = Whitsunday, Tematu- leiwuwau (Wilkes Exped.), Nukutavake (lapsus, Brigham chart), Ngsnati (lapsus, Brigham descr.).

Portland Reef (Reef, 23 40 S 134 30 W).

Puka-Puka (Atoll, 14 50 S 138 50 W) = Pukapuka, Honden, Hondau, Henauke, Dog, Tatakoto (lapsus, Brigham), Clerke (lapsus, Brigham).

Pukaruha (Atoll, 18 19 S 137 02 W) = Serle, Searle, Pukerua or Thrum Cap Akiaki (lapsus, Wilkes Exped.), Reao (lapsus, Brigham chart).

Rangiroa (Atoll, 15 03 S 147 40 W) = Rahiroa, Vliegen, Deans, Nairsa.

Raraka (Atoll, 16 11 S 144 53 W).

Raroia (Atoll 16 03 S 142 23 W) = Barclay de Tolley.

Reao (Atoll, 18 30 S 136 23 W) = Clermont-Tonnere, Natupe, Clermont de Tonnere, Pukaruha, Serle (lapsus, Brigham).

Reitoru (Atoll, 17 49 S 143 08 W) = Bird, Hekueru (lapsus, Wilkes Exped.).

Rekareka (Island, 16 50 S 141 54 W) = Good Hope.

St. Juan Baptist (Approx. 24 S. 38 59 W) = Wilkes Exped.

S. Marutea (Atoll, 21 30 S 135 40 W) = Lord Hood (s), Marutea (Brigham).

Taenga (Atoll, 16 20 S 143 17 W) = Holt, Yermaloff (of Bellingshausen).

Tahanea (Atoll, 16 52 S 144 45 W) = Tchitschagoff, Tchigschagoff.

Taiaro (Atoll, 15 44 S 144 36 W) = King

Takume (Atoll, 15 48 S 142 12 W) = Wolkonsky, Wolchonsky, Takurea or Wolconsky (Wilkes Exped.).

Tatakoto (Island, 17 20 S 138 22 W) = Narcissus, Clerke, San Narcisso, Pukapuka or Clerke (lapsus, Wilkes Exped.)

Tauere (Atoll, 17 22 S 141 28 W) = St. Simeon, Resolution, Tawere (Wilkes Exped.), Tandrec, Taueri.

Tekokota (Atoll, 17 20 S 142 37 W) = Tekokoto, Doubtful, Tekareka (Wilkes Exped.)

Tematangi (Atoll, 21 40 S 140 40 W) = Blighs, Hereheretua (lapsus, Wilkes Exped.), Bligh lagoon.

Tikahau (Atoll, 15 00 S 148 10 W) = Krusenstern, Krusenshorut, Tikehau.

Tikei (Atoll, 14 58 S 144 32 W) = Romanzoff, Tike or Romantzoff (Wilkes Exped.).

Timoe (Island, 23 20 S 134 30 W) = Crescent, Temoe (Wilkes Exped.).

Tureia (Atoll, 20 48 S 138 32 W) = Papakena, Carysfort, Tureie, (Wilkes Exped.).

Vahitahi (Atoll, 18 44 S 138 50 W) = Lagoon, Four Facardins, Cook, Nukutawake or Teay (lapsus, Wilkes Exped.).

Vanavana (Island, 20 45 S 139 10 W) = Kurateke, Barrow, Teku (Wilkes Exped.).

NATIVE USES OF FISHES

Food Resources:

While the 127 Raroians have an unlimited supply of food in the sea only approximately 50 species of fishes are commonly used for food and the natives are rather selective even among these preferred species. The number of kinds of fish that the natives will occasionally eat totals higher, but acculturation gradually makes fishing seem less desirable to them.

According to the natives many of the food fishes at Raroia are seasonal. Also, in their detailed accounts of the individual fishes they indicate that many fishes have seasonal movements around the atoll. The period at Raroia was too short for us to check these notes further.

The natives use no conservation measures and are under the impression that there are just as many fishes as ever before. There are very few tabus relating to fishes (except concerning one species of carangid and several tetraodontids and balistids to be reported upon by Bengt Danielsson). No seasonal restrictions or minimum size limits are involved. Food fishes are as plentiful in the immediate vicinity of the main village (Garumaoa) as elsewhere and the natives have no trouble catching them.

Catch Statistics:

While Hiatt and Strasburg (1951) discuss catch statistics for Arno Atoll, Marshall Islands, it was not possible to obtain similar data at Raroia. Fishing activity varies greatly between families and with time, and as found by Hiatt and Strasburg the interviews on such subjects were not satisfactory. The Raroians live to a great extent on fish while away from the main village (Garumaoa), but the rate of fish consumption while in Garumaoa is much lower; at home they prefer canned foods.

Fishing Methods and Localities:

Bengt Danielsson has prepared a report on native fishing techniques but a brief summary of current methods is presented here. The greatest bulk by volume of fishes are taken with single and four pronged spears in the inter-islet channels and along the shore, both along the outer coralline ridge and lagoon shore. Scarids, labrids, carangids, lutianids and serranids comprise practically all the fishes taken with this means. The natives hook and line fish to a lesser extent, preferring to troll along the outer reef edge over the coralliferous outer bench or in Garue Pass. They usually make their own metal hooks and pearl shell lures. Thunnids, carangids and sharks make up most of the catch. Stationary hook and line fishing is primarily done in Garue Pass, inter-islet channels and to a lesser extent around lagoon coral heads. A short line with a hook is attached to any handy pole. Serranids, acanthurids, and balistids comprise the major part of the catch. No reels are used. The hooks and lines are purchased from the trading schooners.

Stone traps are often erected around schools of fish in shallow water on the outer reef flat and in inter-islet channels; these are only temporary and are destroyed quickly by wave action. Only one permanent trap is maintained at Raroia. This is a stone trap approximately 50 feet in diameter next to shore in the lagoon south of Garue Pass. The natives occasionally take various food fishes out of it, but usually do not bother to keep it repaired. No stick traps are used.

No nets of any kind are now used at Raroia. All of the seining methods are accomplished by coconut fronds.

The only fishing at night is done on the outer reef flat at high tide. The natives slash at the fishes in the shallow water with machetes or other long knives. They use torches or kerosene lamps for light. They primarily take holocentrids and lethrinids (Monotaxis). Usually the boys and young men do this very successful type of fishing.

Poisonous species:

The natives say that the fishes at Raroia poisonous to eat are Meromero (Epinephelus bohar), Tero (Lutjanus marginatus), Tonu (Paracanthistius maculatus), Ono (Sphyraena snodgrassi), Maito (not identified) and Oiri (not identified). Notes on their poisonous qualities are presented under each species in the systematic account.

There are numerous records of ichthyotoxism at Raroia, since the natives sometimes cannot resist eating the particularly fat fishes, even though they know they are poisonous. There was one mild case among the natives while the team was at Raroia which Bengt Danielsson attended. Mr. Danielsson has notes on the cases of fish poisoning at Raroia and will present them in his reports. The natives stated that there were usually about six cases of ichthyotoxism a year, but mentioned no deaths. They also asserted that the number of poisonous fishes varies from atoll to atoll and from season to season. They stated very definitely that certain fishes are poisonous in one locality of an atoll, but completely edible if occurring in another region of the same island. They claimed that the poisonous properties were due to what the fishes eat, but were not sure what the food was that caused the damage. They said that some atolls in the southern Tuamotus had very few inhabitants, since practically all the fishes were poisonous, and the natives could eat only a few of the species.

The venomous fishes are Pugapuga (Synanceja), Tataraihau (Pterois, Scorpaenodes sp. 1), Pugapuga veve (Scorpaenopsis gibbosus), Marava (Siganus), some Acanthurus, all Ctenochaetus, Tapereta (Aetobatus) and the large moray eels (according to the natives). The natives especially fear Pugapuga.

Tuna Baitfish Resources:

Hiatt and Strasburg (1951) have pointed out that baitfish resources may become the most significant marine income to natives on atolls, although this does not appear likely for French Oceania. The only baitfish at Raroia

during June-August was Stolephorus delicatulus. Large schools of young congregated around lagoon coral heads. According to the natives, various Clupeoids come into the lagoon at definite seasons and form huge schools along shore. At such times the baitfish resources would be ample for a tuna fishery. On the off seasons, however, it would be difficult to get even a few scoops of bait. French officials at Papeete, Tahiti, did not believe that there is an adequate source of baitfish anywhere in French Oceania.

Shark Menace:

The natives are afraid of the sharks at Raroia and always leave the water whenever sharks come into the region in which they are swimming. Sharks were particularly abundant and aggressive in Garue Pass and around the outside of the atoll over the coralliferous outer bench and in the surge channels. I was charged twice by sharks while in surge channels, but there were no attacks while we were at Raroia. One woman in the village has an arm missing that was bitten off by a shark when she was a girl.

RAROIAN VOCABULARY FOR ANATOMICAL FEATURES OF FISH

While the information is not complete, some data was compiled for me by Miss Aurore Natua of the Raroian general terms for the parts of a fish (see fig. 2). The natives consider a fish in three basic sections corresponding roughly to head, (Homua), trunk (Koronaega) and tail (Mahiga); the top half of Koronaega and Mahiga is termed Kotika and the bottom half Kopaki and Takere for the respective sections. All of these terms refer to the way a fish is cut up for food. The remaining terms obtained refer to definite anatomical features.

GOREGORE I ROTO.--Skin

GOREGORE I VAHO.--Scales

GUTU.--Tip of snout and lower jaw

HANAA.--Fin; finlet

HAVANAIRARO.--Pelvic fin

HAVENE.--Fat, plump

HOMUA.--Head section including paired fins

KAEHORA.--Gall bladder

KAMIKAMI.--Gill filaments

KEIGA.--Spiny rays [in particular, but in general refers to all fin rays]

KEIGA HAVANA.--Dorsal fin

KEIGA KOPAKI.--Pelvic fin rays

KEIGA MAKUI.--Dorsal fin rays

KEIGA TAKERE.--Caudal fin rays

KOEA.--Flesh

KOHIRI.--Fat about the digestive tract

KOPAKI.--Stomach or belly region

KOPANI.--Breast region between gill openings and pelvic fins

KOROVAEGA.--Trunk region between paired fins and anus

KOTIKA.--Back or dorsal region

MAHIGA.--Tail region of fish behind anus; caudal fin

MOKA.--Milt

NIHO.--Tooth

NOHI.--Eye

OPUPU.--Swim bladder

PAPAHIA.--Liver

PEPENU.--Side of forehead behind eye [extent of region not clear to author]

PEPERERAU.--Pectoral fin

PUTOHE.--Anus

RAE.--Occipital region

ROEROE.--Stomach and intestine; belly region

TAGA RARO.--Lower jaw

TAGA RUGA.--Upper jaw

TAKERE.--Ventral region over anal fin; anal fin (particularly referring to the spines)

TAPAU.--Nape

TEKETEKE.--Roe

TUA.--Back or dorsal region of body

TUKETUKE.--Top of head

UPEREPERE.--To descale

UPOUPO.--Heart

VAEGA HUA MAU.--Mid-lateral line of body

VAHA.--Mouth

NOTES ON SPEAR FISHING EQUIPMENT

While matching wits with the fishes in the field trying to obtain adequate collections the ability of the collectors and the type of equipment used are all important. Fish collecting in shallow water has advanced tremendously within the past few years, and an amazing arsenal of skin diving equipment is now readily available in sport goods stores. It is a lamentable fact that very few ichthyologists are really aware of this advance and even fewer utilize the gear that would greatly increase the ease and ability of collecting coral reef fishes. The best of this equipment is discussed below.

Swimming gear: Around a coral atoll practically all of the worthwhile collecting has to be done by swimming. A swimmer will find Japanese Tabe coral resistant shoes or the Italian Salvani rubber soled swim fins combined with Japanese Tabe socks the most convenient footwear. It is generally recognized that a swimmer should carry a knife strapped to the trunks; the french plastic handled stainless steel dagger that floats is considered the best now on the market. Dull colored (so sharks will not be attracted) nylon trunks are sturdy swimming attire. In rough coral areas deep sea diving underwear, or even regular coveralls, save a lot of coral cuts and canvas-leather gloves offer good protection for the hands. Squale or soft rubber Champion face masks and Squale goggles are by far the best available in this line; the Italians have a better soft rubber face mask but few are obtainable in this country. Constant use day after day will wear the Squale mask out in two months time. Abercrombie and Fitch offer an ingenious crystal Lucite frame made in France for prescription lens that fits in the Squale, Champion and Italian masks. Nose clips are recommended as a necessity for those who have trouble clearing their eustachian tubes. Snorkels are often a great help while swimming along the surface. The Abercrombie and Fitch snorkel seems to be the best, and is made to fit most masks. Seasoned skin divers prefer the lightest and simplest snorkels. The best rubber suit is the Pirelli, but some new foam rubber suits are appearing that are warmer.

Diving gear: Aqua-lung one or two cylinder compressed air rigs are universally accepted as the best for spear fishing. Ichthyologists usually prefer the two cylinder rigs since they last a longer time underwater (one hour) but sport spear fishermen prefer the one tank rig (half hour) since it is much lighter and easier to handle. Fenjohn Co. makes a canvas vest for the one tank rig that is a big improvement over the original straps, and also sell a small gasoline powered compressor for charging cylinders.

Spear fishing gear: Ichthyologists have not utilized the tremendous advances that have been made with this type of equipment, particularly in regard to compressed air guns. The best commercially available hand spear is a sea net A 77 with an H 23 needle point head; this is a 10½ foot aluminum spear that unscrews into sections; it has a rubber loop at the end of the handle. There are many good rubber sling guns: The best of the Hawaiian type are the sea net pistol grip (but should be modified), and the Abercrombie and Fitch plastic models. Hawaiian slings can be easily made in the field

providing rubber tubing is available. The best cocking rubber sling gun is probably the Italian Cressi, since it is especially made for close work around coral. Also very good is the French single sling Arbelete (this gun is sold under a variety of names, but most are the same); a front grip can be added for greater accuracy. The best steel spring gun is the Italian Cressi, but the noise of the spring alerts the fish. There are other elaborate Italian and French spring guns, but I find them too complicated and too hard to cock. It is questionable as to what air guns on the market are the best, since new ones are coming out every month. Apparently the Fisher CO_2 GN - 6 (uses liquid CO_2; fires 10 shots per load; for large fish only) and the light Barracuda (uses CO_2 capsules; single shot) are the most popular. Both are easy to load and handle, especially the latter. I have just tried the Neptune, which has recently come out in California. It is almost as good as the Barracuda and is lighter. Most of the compressed air guns on the market are dangerous and awkward to handle, particularly when loading, so that it is necessary to be cautious when obtaining this type of gun. They have an accurate range of 50-80 feet underwater and open up a relatively untapped region of fish collecting. Many fishes stay just out of range of rotenone and hand spears that can easily be obtained with compressed air guns.

Safety gear: As previously mentioned under swimming gear, it is advisable to wear a dagger while swimming. Inexpensive depth gauges worn on the wrist are an aid for measuring depths and for decompression. Shark repellent should be used in tropical regions. Despite a few accounts to the contrary, it has repeatedly been proven that the copper acetate repellent is very effective against sharks. Under some conditions a Res-Q-Pak is worthwhile having. This is a small plastic package that is blown up by a CO_2 cartridge when squeezed. A good collecting and safety device is an innertube float covered with canvas to form a receptacle for fish. A line is fastened around the outside and an anchor line is attached to it with a small crow bar on the end. It is important that speared fish be taken out of water as fast as possible so that sharks will not be attracted; the canvas floats are perfect for this. Also they can hold the dipnets, swim fins, bottles, compressed air cylinders for Aqua-lung, CO_2 master tanks for compressed air guns, and can be used as a place of refuge in case of shark attack. Since a swimmer cannot normally handle a speared fish larger than himself the line can be attached to the float and the fish played from the float.

Nets: In this category dipnets are the most important. The best I have found is the 20" diameter Ocean City, N. J., aluminum dipnet, with screws for taking off the hoop, and removable handle. These are fitted with nylon netting bags, which stand up very well in the tropics. Small aquarium nylon dipnets, common seines, gill nets, trammel nets and throw nets are all worthwhile for coral atoll work. Ederer Net Co., Philadelphia, is most cooperative to expeditions and quite reasonably priced. Probably a dome-shaped fine mesh net approximately 25' in diameter would be useful in poisoning coral heads. The dome should be buoyed and the entire net could be placed over the region to be poisoned, and few of the fish would escape.

Ichthyocide: Powdered rotenone is the most commonly used. It must be freshly ground as fine as possible and preferably packaged in 5 or 10 lb. air tight packages, or better yet -- canned with a home can sealer. Highly concentrated liquid rotenone is far more effective in tropical regions but higher priced.

The importance of the quality and effectiveness of underwater equipment cannot be overemphasized and can make a tremendous difference in the success of field work. Since skin diving is progressing so rapidly, atoll team members should check with Florida or southern California sport fishing stores for the latest advancements.

CONCLUSIONS

Raroia Atoll supports a very large marine fauna both in the lagoon and on the outer reefs, that is not appreciably depleted by the native population. The relatively large size of the atoll allows for a great range of physical and ecological variation and the time and resources of the team were taxed to the limit trying to study even the representative situations. It would seem from the literature, however, that such atolls in the Tuamotus as Makemo, Tahanea, Anaa, Takaroa and Hao must have richer marine faunas, although the fish population of some of these islands may be affected by the fishing intensity of larger native populations than are on Raroia.

The outstanding features of Raroia are (1) the presence of a moderately broad coralliferous outer bench around the atoll that supports the heaviest coral growth and largest fish fauna of all the major ecological zones; (2) the development of surge channels completely around the atoll that are extremely porous and cavernous on the southwest side of the atoll; this ecological zone contains a specialized fish fauna that for a great part was found nowhere else; (3) a broad outer reef flat exposed at low tide that is a feeding ground for many groups of larger fishes at high tide; (4) the single deep pass into the lagoon on the west side of the atoll that supports an amazingly large fish fauna and allows for the free passage of larger fish in and out of the lagoon; (5) the numerous inter-islet channels around the atoll that sustain a moderate fish fauna of smaller species; (6) the deep lagoon with numerous flat-topped coral heads extending to the surface; while there appears to be a relatively small fish population in the open water of the lagoon there is a large fish fauna around and on top of the coral heads. In summary it should be noted that the coralliferous outer bench probably supports almost half the fish fauna at Raroia, and this zone plus the surge channels, deep pass, and lagoon coral heads support about three-fourths of the fish population at Raroia.

Currents are an important factor in the distribution of fishes on the atoll. There is a lag between tides inside and outside the lagoon, causing a constant flow of water across the lagoon towards the west and south. At extreme high tide water flows into the lagoon through almost all the channels. At low tide by far the greatest volume of water flows out through the deep pass and over the broad southern flat. In the lagoon the coral heads near the deep pass and in the southwest region near Oneroa maintain the largest fish populations, apparently receiving the greatest flow of nutrient materials. The character of coral heads and other coral growth in the calm protected waters next to the east and north islets are strikingly different than elsewhere around the atoll. It is probable that the lagoon coral heads could be divided into several ecological units depending upon their position in the lagoon and resulting modification of habitat. Also the volume of water flow in the inter-islet channels has a profound effect on the life of this region, there being a noticeable change between the various types of channels and between channels of different parts of the atoll.

One of the most interesting aspects of the Coral Atoll Project was the comparison of the ecology of Raroia and Takume Atolls, situated approximately

fifteen miles apart. Raroia has a deep lagoon, major passes to the outside, and supports a large coral reef fauna in its lagoon. Takume has a shallow enclosed lagoon with minor channels to the outside and supports a small coral reef fauna in its lagoon remarkably different in balance than that of Raroia. While these two atolls may have the same species, their relative abundance and ecological associations are clearly very different. Fishes that were seen only once or twice during the entire period at Raroia were noted to be common at Takume and vice versa. These facts do not refer only to the lagoon, since even certain physical aspects of the outer reefs were strikingly different and must have had a corresponding modification of ecological conditions. In many ways a comparative ecological study of atolls in one group would be more revealing than comparing islands from widely separated regions.

It is difficult to estimate at this time the relative success of the Raroian ichthyological study. Somewhat less than twice as many species were collected at Raroia Atoll than are known in the literature for the entire Tuamotu Archipelago. But it seems safe to state that at least 100 more species would have been collected, as well as much more useful data obtained, if the bulk of the ichthyological equipment had been available. Probably the main contributions that can be obtained from the collections and field data are the (1) determination of the relative abundance of species and zoogeographical relationships of the fishes of this area, (2) establishment of identifications for approximately 150 Tuamotuan native fish names, (3) elucidation of some economic aspects, such as identification of poisonous fishes and food fishes and their relative importance, (4) establishment of a basis for a systematic study of the fishes of the Tuamotu Archipelago, (5) contribution of data on the habits, habitats, distribution, and other ecological aspects of coral atoll fishes. No small factor is how successfully the data is utilized for final publication. The author is greatly indebted to Mr. George Vanderbilt for generously sponsoring both the field work and subsequent research. It is planned to complete investigations on the Raroia material along with the Vanderbilt 1951 Expedition collections family by family, culminating in a general systematic and ecological monograph.

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FIELD STATIONS OF THE
ICHTHYOLOGICAL SURVEY
Tuamotu Archipelago
RAROIA ATOLL
0 1 2 3 4
Kilometers
Photogrammetric base, N. D. Newell

FIGURE 1

RAROIAN NAMES FOR THE PARTS OF A FISH

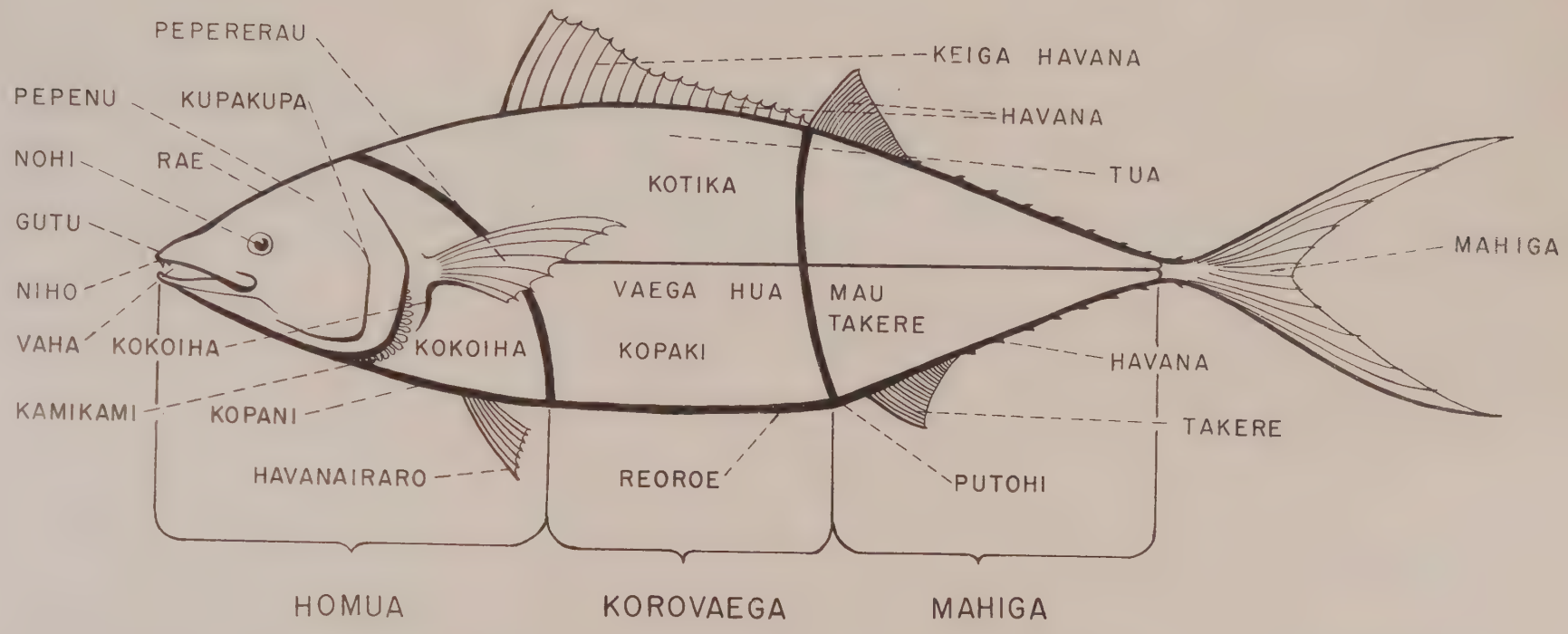
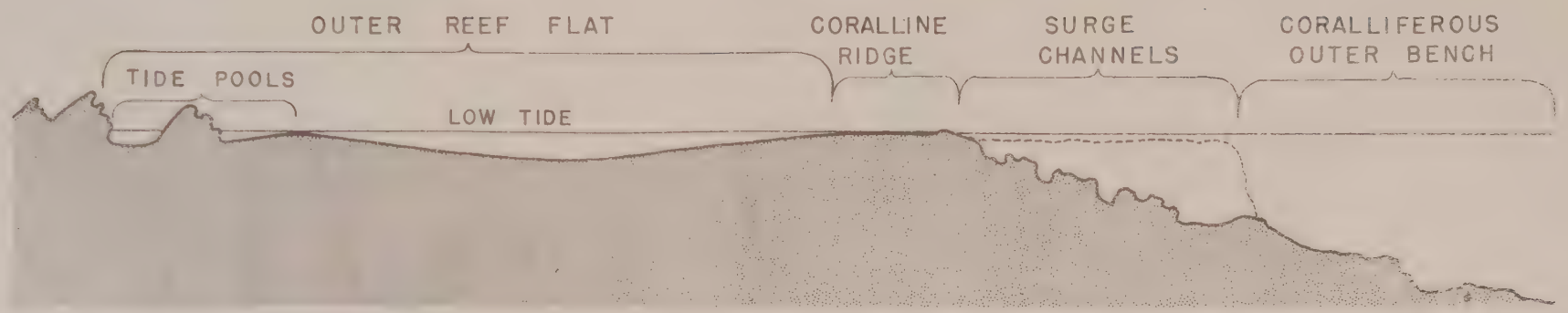


FIGURE 2

ECOLOGICAL ZONATION OF FISHES ON OUTSIDE REEFS

ISLAND PROFILES OF RAROIA ATOLL



ECOLOGICAL ZONATION OF FISHES ON LAGOON REEFS

ISLAND PROFILES OF RAROIA ATOLL

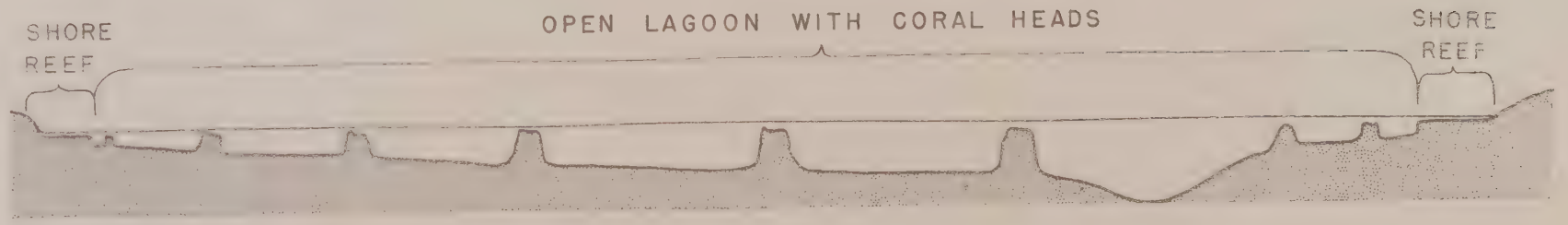
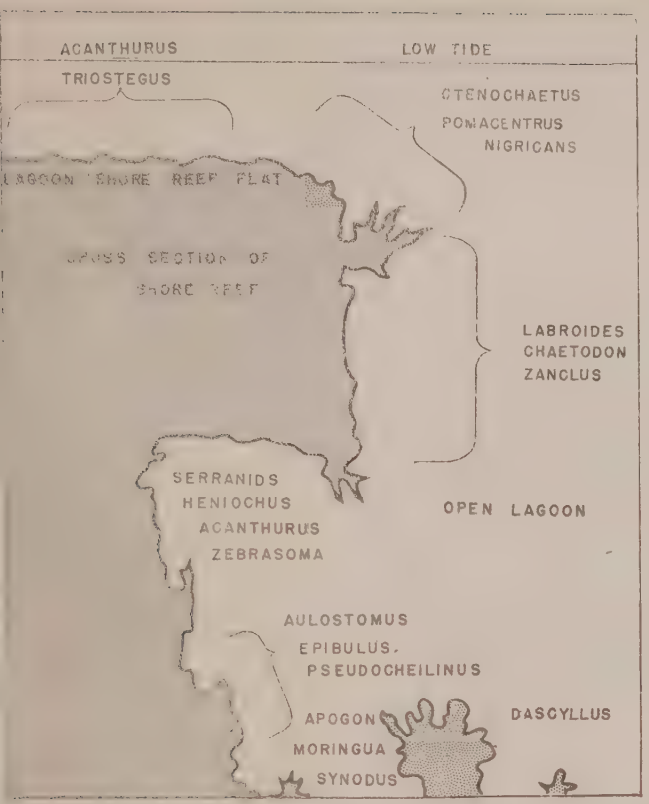
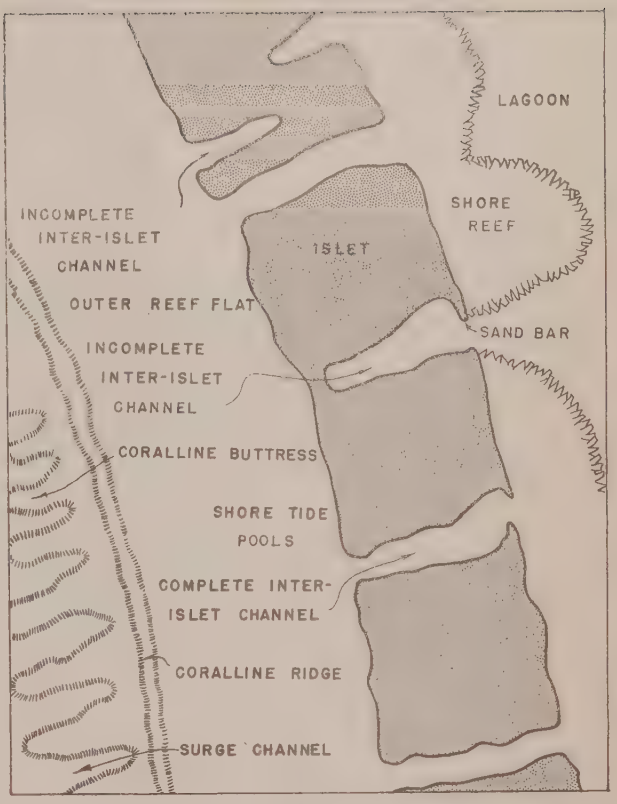


FIGURE 3



ECOLOGICAL ZONATION OF FISHES ON SHORE REEF FACE WEST SIDE RAROIA ATOLL

FIGURE 4



ECOLOGICAL ZONATION OF FISHES AROUND ISLETS OF RAROIA ATOLL

FIGURE 5

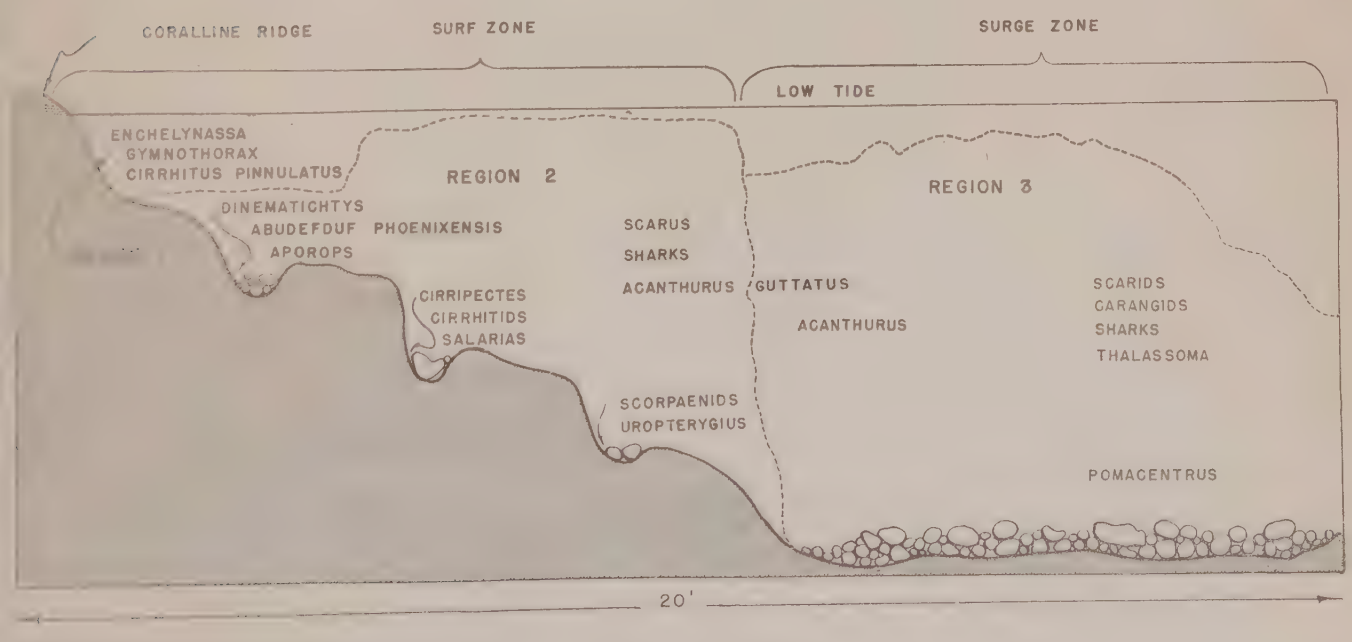


FIGURE 6 DAYTIME ECOLOGICAL ZONATION OF FISHES IN SURGE CHANNELS RAROIA ATOLL

ECOLOGICAL ZONATION OF FISHES ON SMALL LAGOON CORAL HEADS

RAROIA ATOLL

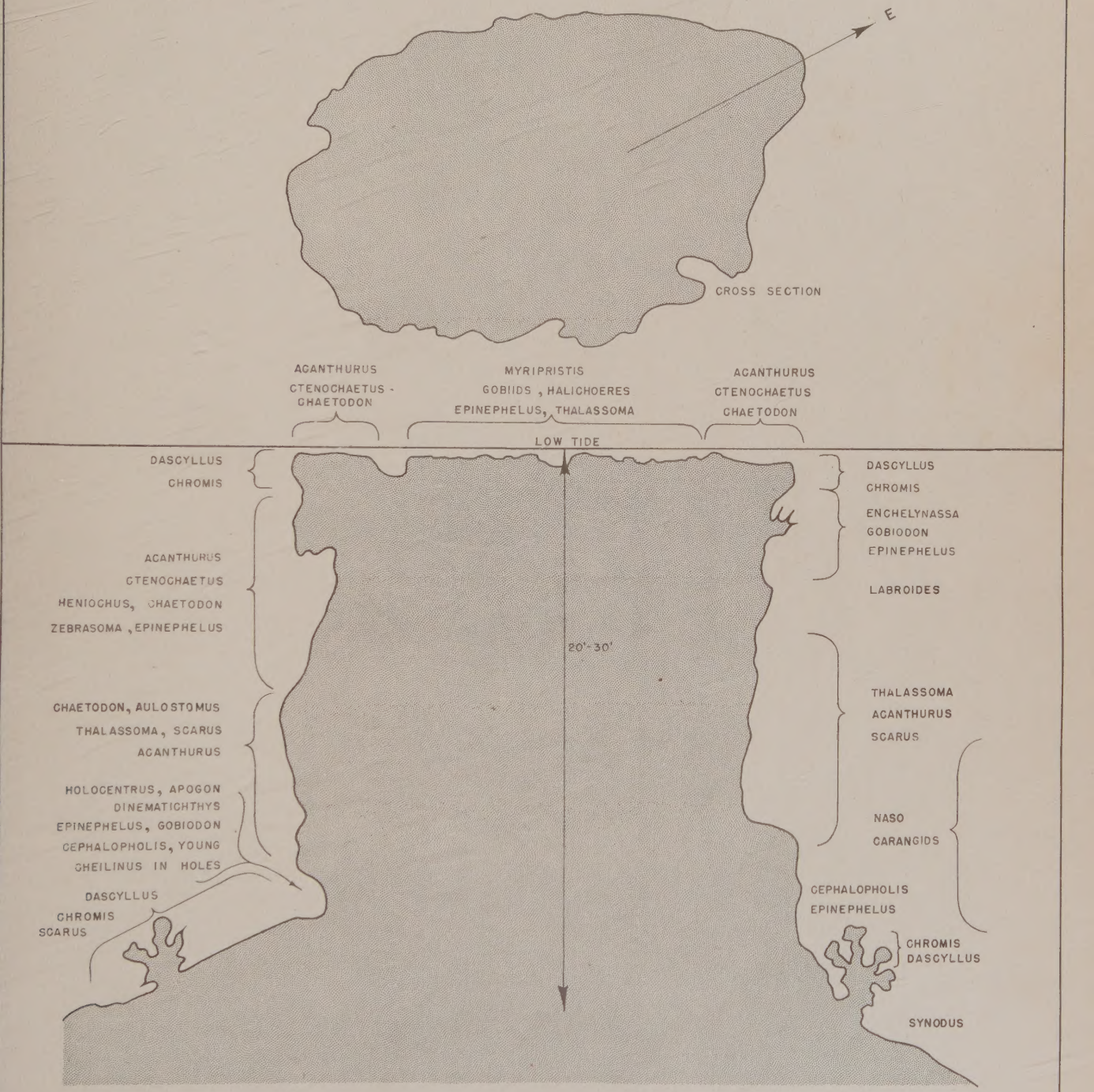


FIGURE 7